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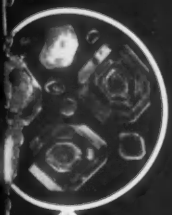

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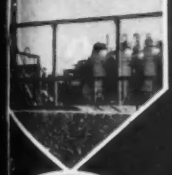

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SAFETY INGREDIENT OF CHEMICAL EXPERIMENT

Better No Tests Than Lose Eyes and Hands

Page 1

Highlights from ACS Meeting 8
Chemicals from Trees 13
Hyperdermic for Trees 14
Chemicals in the Paper Industry 16
Gout — The Mystery Disease 21
Fallout and Public Health 24
Association of Agricultural Chemists 29
Chemistry Quiz 31
Electrolysis of Organic Compounds 32
For the Home Lab — Orange Dyes 38
Hereditary Chemical of Life 40
Protein-Like Molecule Built 41
Chemical Destroys Virus 44
Magnetism in Plastic 45
Do You Know — New "Short" Feature 47
Book Condensations 48

Editorial:
Be Safe In Experimentation
Inside Front Cover

50¢

A SCIENCE SERVICE PUBLICATION

XUM

Be Safe in Experimentation

➤ AMERICAN INDUSTRY is proud, and justly so, of its safety record. Laboratory work in schools and hobby activities, as well as professional research, needs the same protection against dangers that have become cutomary and standard in industrial establishments.

The interest in rockets and missiles among young scientists has reawakened interest in explosives. Too often there is a desire to try to manufacture explosives and operate devices that can be deadly in unskilled and unprepared hands.

But the dangers are not confined to explosives and materials that are labeled "poisons." The home, with its many devices using gas, electricity and whirling blades, is the place where many accidents occur. The housewife uses with abandon and sometimes little understanding such chemicals as ammonia, lye, and acids. The medicine cabinet contains deadly materials when improperly used.

One of the great usefulnesses of chemistry courses for those who do not intend to become chemists is the understanding that it gives of the dangers as well as the usefulness of chemicals.

Chemistry courses should emphasize safe and effective methods of performing experiments and "learning by doing." There are precautions to be observed in the generation of hydrogen, for instance. If an experiment is being performed that may blow up if something goes wrong, it should be shielded behind protective screens. A ventilated place should be used for any reaction that may give off poisonous gases. There should be a fire extinguisher close at hand. The safety devices need not be expensive but may be home-made if it is realized what it needed.

Apparatus supply houses and professional organizations have given attention to chemical safety and the lead article in this issue of CHEMISTRY summarizes suggestions and gives references to more information.

It is better to be cautious and safe and save an eye or a hand for future use.

CHEMISTRY

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Science Service is the educational and scientific institution organized in 1921 as a non-profit corporation with trustees nominated by the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, the Scripps Estate and the Journalistic Profession.

➤ HANDS ARE *well protected with safety gloves when laboratory workers at General Electric handle nitrile silicone rubber at "dry ice" temperatures.*

First Safety: Then Chemistry

➤ SAFETY concerns us in every phase of modern life, but it is especially important today in the chemistry laboratory. Here, in order to study the structure of matter and all the exciting ramifications of this fundamental science, certain risks must be encountered. Dangerous chemicals have to be studied and used, and the growing uses of radioisotopes, beneficial in so many ways, present a safety problem all by themselves. Many dangers have been eliminated or lessened by our increased understanding of chemical compositions and chemical reactions, and accidents can be minimized when precautionary measures are used.

In the laboratory, housekeeping is one of the most important parts of any experiment. If chemicals and

equipment are well labeled and stored, chances of breakage or misuse are greatly reduced. Any assumption in a laboratory where poisonous chemicals are concerned may be tantamount to severe illness — or sudden death. For instance, that black unlabeled container you are sure contains copper oxide, because you "put it there yesterday" — throw it away! You should have labeled it. The wash bottle which held distilled water an hour ago might easily contain a poisonous liquid now, although the same bottle should never have been used for both. A pipette may have been filled a thousand times by mouth suction without a mishap, but this does not exclude the danger of the "once too often."

Poison and Toxicity

Practically all chemicals handled in a laboratory are "poisonous" if swallowed. It is a question of degree. A good general rule is never to taste anything in the lab, and to smell a chemical only when necessary by wafting a small amount of vapor with the hand toward the nose.

In every procedure which may produce toxic or poisonous fumes, local exhaust ventilation should be applied. Remove harmful gases and vapors at their source. Always wear a gas mask having an absorbent specific for the gas being used. Poisons can accidentally enter the system by breathing and by absorption through the skin. Many organic compounds, such as phenol (carbolic acid) and aniline, and some inorganic ones, are rapidly absorbed through the skin, causing systemic poisoning. Phenol is also very destructive to tissue.

Extremely hazardous compounds such as cyanides and fluorine compounds should be followed step-by-step by a check method from the time they leave the storage shelves through their final disposal. The laboratory can be assured this way that non-technical personnel are protected from this hazard.

Burying highly toxic compounds is not always the safest method of disposal. In many cases only the ingenuity of the chemist can solve the problem of safe disposal of toxic or explosive materials. He can often render wastes harmless through the application of appropriate chemical procedures.

If someone is poisoned, vomiting should be induced immediately and repeatedly except where poisoning is due to strong acids or strong alkalies. The most commonly used emetic is prepared by stirring one teaspoonful of powdered mustard in sufficient warm water to make a creamy paste. Lacking mustard, warm salt water or ordinary soap suds may be administered. If the nature of the poison is not known, the following universal antidote can be used:

Universal Antidote
2 parts Pulverized Charcoal
1 part Magnesium Oxide
1 part Tannic Acid
Keep dry until ready for use. Dose: one heaping teaspoonful in a small glass of warm water.

Chemicals need not be dangerous if they are properly used and understood, and if experiments are conducted in surroundings where adequate ventilation, fire extinguishers, and personal safety equipment such as safety glasses, gloves, tongs, and first aid materials are available. It should never be too much bother to put on gloves or a mitten or to remove a pair of

tongs from a rack when handling hot objects.

Use of safety tools can become second nature, but like brushing your teeth, habit forming takes practice.

Acids and Alkalies

The burning effects of strong acids and alkalies cannot be overemphasized. They can destroy human tissue if not washed off immediately. The most hazardous acids would include hydrochloric, hydrofluoric, sulfuric, nitric and perchloric.

The organic acids as a class, characterized by the presence of a COOH group, are much less hazardous because of their comparatively low ionization potentials, and because few, if any, of them "fume." Hydrocyanic and oxalic acids, along with phenol, are extremely hazardous compounds, not because of their acidic properties, but because of their toxicity. From elementary chemistry on through a professional lifetime, one simple maxim is universally known: Pour acid into water — never pour water into acid.

Most acid hazards can be overcome by proper technique and handling. Always flush the outside of acid bottles before opening them. Do not lay the stopper down on any surface where the next person may rest his hand or arm. Keep acid bottles stoppered tightly and flush and dry them before replacement on the reagent shelf. Make certain that no spillage remains on tables, floor or bottle.

If a strong acid has been swallowed, administer milk of magnesia or lime water.

Perchloric acid is highly corrosive and has strong oxidizing and explosive properties. Like all explosives, it should be respected. Protective rubber

➤ THIS SILICON *pulling apparatus is being operated in the semi-conductor test laboratory at the Washington Research Center of W. R. Grace & Co. Note the eye protecting goggles.*

garments such as gloves, sleeves, or aprons, are imperative, as well as eye shields or anti-splashing goggles. One drop of this acid splashed on the eye will almost certainly cause the loss of that eye. Combustible materials, such as sawdust, wood, paper, burlap bags, cotton waste, rags, grease, oil, and most organic compounds, containing perchloric acid solution, are highly flammable. They may explode on heating, contact with flame, impact, or from friction; or they may ignite spontaneously.

Strong alkalies, such as sodium hydroxide, potassium hydroxide or ammonium hydroxide should be handled with the greatest of care, whether solid or in solution. Even dilute solutions are dangerous through contact with the eyes, and minute quantities of the solid may cause severe eye in-

juries. The molten solid is perhaps the most dangerous form, capable of producing blindness, even when the speediest medical treatment is applied.

If a strong alkali is actually swallowed, give 5% acetic acid or olive oil. Then give a demulcent drink such as 3 to 5 grams of dried egg albumen in a glass of cold water. The white of an egg, a glass of milk or a tablespoonful of mineral oil will do if the albumen is not immediately available.

Explosives

Many chemical mixtures are explosive, even though the individual substances alone may not be. Some mixtures not immediately explosive become so after standing a while; for instance, the solution used in silvering glass, a common high school experiment, becomes spontaneously and violently explosive when allowed to stand for several hours.

Often encountered in the laboratory are materials which may polymerize on standing. Since most polymerizations are exothermic, spontaneous explosions may result unless the necessary precautions are taken. Examples would include the polymerization of diketene, ethylene oxide in the presence of powdered potassium hydroxide, and vinyl compounds. Liquid oxygen and liquid air are likely to produce an explosion when mixed with hydrocarbons or other combustibles.

Acetylene, under certain conditions, forms highly explosive metallic compounds such as acetylides of copper, silver, and mercury. Silver fulminate and other nitrogen-containing compounds can be explosive.

Phosphorus, when not surrounded by air, burns freely, and can cause severe local tissue burns which are very painful and heal slowly. Compounds of phosphorus on the skin result in the formation of meta- and orthophosphoric acids and small amounts of red phosphorus.

Phosphorus is also extremely poisonous, about 0.1 gm. being a fatal dose. (White phosphorus, incorporated into flour, is used in certain rat poisons as the active ingredient.) Continued consumption of small amounts will lead to chronic poisoning, beginning with anemia, loss of appetite and weight, and a tendency to bleeding in the mucous membranes. Characteristically there is a destruction of the jawbone which starts with a thrombosis of the bone vessels and is secondary to carious teeth. The bone becomes brittle, painful, and there is infection of the jawbone which can lead to a general sepsis.

White phosphorus ignites spontaneously in air and burns vigorously. For purposes of safety it is handled under water. If combustion occurs in a confined space, the oxygen is consumed and asphyxiation can occur.

In the listing of chemicals by the average industrial chemist, carbon disulfide is always put near the head of the list in terms of hazardous chemicals because of its extreme flammability. It has a low flash point, a wide explosive range, and an extremely low ignition temperature — only 100 degrees Centigrade. Contact with the surface of an ordinary electric light bulb will cause ignition. The vapor, mixed with air or oxygen explodes when kindled, the most violent explosion being obtained with $2CS_2 + 5O_2 = 2CO + 4SO_2$. Inhalation of the vapor, prolonged or repeated contact of the liquid with the skin, or oral intake, can be harmful.

Like phosphorus, it is poisonous enough to be used to kill moths in furs and rats and mice in grain elevators. The signs and symptoms of carbon disulfide poisoning are the result of injury to the nervous system, usually by long-continued exposure to relatively low concentrations of vapor. The compounds can dissolve fat and can remove it from the skin, causing dryness and cracking, and producing sites of entry for harmful bacteria. Contact with the skin may cause only a temporary reddening and a burning sensation. If the liquid is not allowed to escape by evaporation, there may be extreme pain almost immediately, and later a more or less severe chemical burn.

A word of caution about potassium permanganate. This powerful oxidizing agent used in bleaching and tanning, is highly explosive. The story is told of two graduate students at the University of Illinois who planned to do some experimental work with a mixture of powdered potassium permanganate and powdered sugar. Unfortunately they were never able to do whatever they had in mind. A detonation of this explosive mixture killed them both.

Fires and Burns

Basic to reduction of fire hazards is the proper choice of construction materials, adequate means of exit, adequate space between benches, ventilation, and fire extinguishing systems. Defective electrical wiring, sparks from unshielded electrical apparatus, carelessness with gas burners, fires in fume hoods, and ill-advised use of inflammable or explosive liquids are leading causes of laboratory fires.

Wherever there are electrical outlet plugs, wiring or connections, there is danger of fire. All permanent or semi-permanent wiring should be installed by an electrician either with conduit or BX cable to eliminate the danger in connecting many extensions from multiple receptacles.

The first step in an electrical fire is to pull the switch, then use a CO_2 extinguisher (since it is a non-conductor of electricity). Use the utmost caution to avoid becoming part of the circuit. Remember that a carbon tetrachloride type of extinguisher may produce poisonous phosgene when the tetrachloride becomes very hot. Carelessness with gas burners, or with any direct use of open flame may result in a fire. If a poisonous gas is given off by a fire and the proper mask is not immediately available — or if the fire gets beyond the control of extinguishers at hand — get away from the room entirely.

Precaution is always the best fire fighting technique. For instance if there are, in the laboratory, toxic materials which present a fire risk, it is preferable to locate the extinguisher outside of the room so that a worker will not have to be exposed to noxious fumes to get an extinguisher. Hazardous work can be isolated by cutting off the operation adequately with fire walls. Openings around piping and equipment which pierce floors should be filled to prevent spread of fire from floor to floor. An approved fire alarm system with enough gongs to alert all occupants can be provided. Wherever a hazard of accidental release of toxic gases exists, a gas alarm system to warn occupants to evacuate the building should be provided, and masks of oxygen or compressed air type should be located near exits.

Burns can be caused by ultraviolet light, infrared rays and extremely cold materials. Use goggles when working with extra-visual light and limit the time of exposure. Never touch or hold dry ice or liquid air.

For first degree burns, determine the cause, if possible, before treatment is begun. Except for treatment of hydrofluoric acid burns, the general first aid (after flushing and neutralizing) is to cover the burn with sterile petroleum jelly and protect with gauze bandage. Do not break any blister. With any burn, regardless of degree, remember that the extent of the area seared is of extreme importance governing the first aid rendered. With extensive second or general third degree burns, the victim may go into shock rapidly. Treat for shock first, then examine the damage to determine its extent. Cut the clothing from around the burn but do not attempt to pick charred material from the injury. Do not, under any circumstances, use tincture of iodine on any burn because of its tendency to increase skin damage.

Glassware

Most chemical laboratory work involves the use of glassware, and glass breaks easily. Never try to force thistle tubes, glass rods and borers through corks with complete disregard for proper technique. Serious lacerations are bound to result. Deep lacerations of the body at points where pressure cannot be applied directly to arteries or large veins are best controlled by placing a thick padding of sterile gauze directly over the wound. Firm, constant pressure on the gauze is necessary until a clot forms.

Glassware might look cold, but as you can never be sure, a good maxim is always to use tongs.

Many laboratories now store all glass bottles of flammable liquids, hydrogen peroxide and similar materials within metal or stoneware receptacles sufficiently large to contain the entire volume in event of glass breakage. Shatterproof glass guards can protect workers from flying particles and liquids.

Polyethylene containers are now reducing many breakage hazards. In addition to being unbreakable, chemically inert, and lightweight, in a new high temperature form polyethylene is quite rigid, with an increased density and tensile strength, and a softening point above 250 degrees Fahrenheit.

Radiation

The number of people in chemical laboratories and industry who will be exposed to radiation hazards is increasing rapidly as a result of the spreading use of radioisotopes produced.

Critical amounts of radioactive substances destroy white blood cells when the skin is exposed to the rays from them or if they enter the respiratory tract accidentally; hence, persons working with these substances require constant protection.

In radiochemical laboratories, contamination may be encountered on tools, glassware, working surfaces, clothing, hands, biological materials, waste, and in the air, and unwittingly transferred from one object to another. Unless adequate precautions against contamination are taken, some radioactive material may find its way into the body by inhalation, ingestion, or through cuts and abrasions on ex-

posed areas of the skin. For some materials, absorption through intact skin is also possible. The only methods by which this internal radiation can be removed from the body are natural elimination — which is frequently uncertain — and radioactive decay — which may be extremely slow.

Safeguards against radioactive dusts are important, since materials inhaled as dusts or taken in through wounds are more readily dissolved into the blood stream and deposited in the body than materials ingested.

Waste disposal is a serious problem today, and many organizations, both private and public are trying to evolve new methods. The two used most extensively at the moment are burial on land and burial at sea in suitably weighted steel containers.

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Fisher Manual of Laboratory Safety, Fisher Scientific Company, 203 Fisher Bldg., Pittsburgh 19, Pa.

Laboratory Emergency Chart (Fisher).

Guide for Safety in the Chemical Laboratory, D. Van Nostrand, 1954.

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Safety Education Data Sheet - 14, National Safety Council, 425 Michigan Ave., Chicago 11, Ill.

Plastic Forms Make Concrete Effects

➤ UNUSUAL architectural effects are being obtained through the use of plastic forms for shaping concrete.

J. A. Hanson, development engineer of the Portland Cement Association in Chicago, told the American Concrete Institute meeting in Los Angeles that architectural treatment may consist of both surface finish and pattern decoration.

The plastic forms enable concrete surfaces to be made glossy smooth or textured. Pattern decoration is achieved by vacuum forming the plastic sheet over wood, plaster, metal, glass or other pattern materials.

The extremely smooth finish of plastic-formed concrete, said Mr. Hanson, greatly improves the attractiveness of "built in" colors. With the higher reflectivity of the smooth surface, smaller amounts of pigment are required to obtain a given color intensity.

Mr. Hanson said the plastic is still relatively expensive, but tests have indicated that at least ten reuses can be obtained from each form if it is given a reasonable amount of care in cleaning and handling.

Substance Improves Rubbers

➤ A SUBSTANCE that makes natural rubber hold air as well as the best of synthetics has been discovered by Richard T. Morrisey of the B. F. Goodrich Company. Known as brominated butyl, it is expected to be used as an adhesive in the manufacture and retreading of tires.

The substance can extend the lives of natural rubber products by protecting them from deteriorating effects of ozone.

ACS Meeting

Highlights from the 135th National Meeting of the American Chemical Society at Boston in April

Coenzyme A Synthesis

Coenzyme A, believed to be related to the vitamin B complex, has been successfully synthesized more than ten years after the discovery of this vital material.

➤ THE CHEMICAL synthesis of a complex natural substance, needed by every cell of all living things, has been achieved.

Hailed as a significant advance in the quest for a complete understanding of life processes, the test tube production of coenzyme A was described by Drs. John Moffatt, and H. Gobind Khorans, University of British Columbia, at the meeting.

A way to make coenzyme A has eluded chemists ever since the vital material was discovered in 1945. The British Columbia scientists had been working on the project for about seven years. The total synthesis has opened a whole new field of biochemical research into life processes.

Some scientists regard the availability of the coenzyme as having special significance for the important study of nucleic acids. These acids are the basic cell materials for every living thing, and determine the characteristics of the cell.

The chemical triumph has earned high praise from other outstanding scientists. The discoverer of coenzyme A, Noble laureate Dr. Fritz Lipmann of the Rockefeller Institute for Medical Research, New York, observed:

"This feat is a beautiful piece of chemical artistry in putting together a most complex biochemical unit."

Although less complicated than the enzymes with which it works, coenzyme A is an elaborate arrangement of carbon, sulfur, nitrogen, phosphorus, oxygen and hydrogen atoms linked together. Part of the coenzyme A molecule is pantothenic acid, a growth factor which is part of the vitamin B complex. In fact, the coenzyme is thought to be the biologically active form of pantothenic acid.

Living Insecticide

➤ A LIVING insecticide which will not harm man, animals, or plants was announced at the meeting. Called Thuricide, it is made from the living spores of the microorganism Bacillus thuringiensis Berliner.

Dr. Robert Fisher, Bioferm Corporation, Wasco, Calif., called his volunteers for the human studies "pioneers," because no such previous experiments had been made. The U. S. Food and Drug Administration on Dec. 10, 1958, temporarily allowed the chemical to be tried on humans because scientific data showed "the proposed use as a pesticide is without hazard to health."

Thuricide is the first microbial insecticide to receive such a recognition of safety.

Drug Aid

➤ NICOTINAMIDE, an essential vitamin used in the treatment of pellagra, increases the tranquilizing effects of certain drugs.

Tests with laboratory animals showed that when the vitamin was given together with reserpine or chlorpromazine, there was a "grater reduction of spontaneous activity of mice." Also anesthesia induced by these two drugs was effective for a longer time when nicotinamide was given. Drs. Robert M. Burton, Washington University School of Medicine, St. Louis, Nathan O. Kaplan, Brandeis University, Waltham, Mass., and Abraham Goldin, National Cancer Institute, Bethesda, Md., reported results of their research to fellow scientists.

Previous research had shown that giving nicotinamide results in a large increase of the coenzyme diphosphopyridine nucleotide (DPN) in an animal's tissues.

Since DPN is involved in many of the body's reactions, the scientists said, the high concentration obtained with nicotinamide may be related to the tranquilizing effect.

The researchers found it was necessary to give the vitamin at the same time as the drug or four hours after to get maximum effects. Giving it four hours before did not increase DPN levels.

These studies may provide more information on how tranquilizers work, and result in tailor-made drugs.

"Since mental health is the chief medical problem today, the study of neurochemistry assumes considerable importance," the chemists pointed out.

Muscle Relaxant

➤ A NATURAL protein-free substance has been found that causes muscles to relax.

The finding of this substance may help scientists to understand diseases where muscle relaxation is not normal, Drs. Charles J. Parker Jr. of Massachusetts General Hospital and John Gergely of Harvard University told the ACS meeting.

The two biochemists had shown last year that the chemical system for relaxing muscles has three different components. Further studies have shown that when all three of these elements are together, the new-found substance can be extracted, and made to prevent the contraction of muscle threads.

The discovery is important for understanding the basic chemical mechanism by which muscles contract and relax, Dr. Gergely told Science Service. Muscle action can be either reflex or voluntary, he explained, but the chemical action within the cells is the same in either case, and the extracted substance seems to be the basic controlling factor.

It is known the extract is protein-free and has no tissue or cells, but it has not yet been named, and further studies must be made to determine its characteristics.

Tobacco Smoke

➤ HEAVY SMOKERS may have a shortened life span because of the protein-changing ability of tobacco smoke.

The chemical acetaldehyde, used in perfumes, is also present in tobacco smoke and apparently reduces longevity by stiffening connective tissues, Dr.

F. Marott Sinex and Barbara Faris, Boston University School of Medicine, told an ACS press conference.

Acetaldehyde is so reactive that the moment a puff of smoke enters the lungs, the chemical seeks to combine with proteins.

Dr. Sinex exposed kangaroo tail tendons to water and passed them through puffs of cigarette smoke. It took the tendons 20 times longer to shrink when in the presence of the smoke. This could be analogous to the stiffening of tissues found in aging bones, skin, blood vessels, and especially lungs, Dr. Sinex explained.

Kangaroo tendons were chosen because they have the purest bulk source of the important body proteins collagen and elastin. Elastin is the chief protein component of lungs and blood vessels. Protein is chemically the same anywhere in the living body and presumably reacts the same regardless of location, Dr. Sinex said.

He also suggested a process which might counteract the adverse effects of tobacco smoke.

The amino acid cysteine is capable of reversing the stiffening action of cigarette smoke, and might protect smokers from injurious effects of compounds such as acetaldehyde. But the amount necessary at the moment to give protection would induce serious physiological consequences, Dr. Sinex cautioned.

Plastic Smoke

➤ FOAM PLASTIC smoke may soon be used for tracing rockets and satellites.

This prediction was made by the inventor, Miss Betty Lou Raskin, Johns Hopkins University, Baltimore, Md.

The smoke is composed of minute foam particles, which could be metallized. This reflecting material could then follow a rocket or satellite and make possible greater echoing for radar tracking of these targets.

"Since it is believed that these particles will not simply float in space, but, because of their electrical charges, will be in some kind of orbit, smoke distortion patterns produced by rockets and satellites might also be found to have scientific value," she said.

The strategic placing of metallized particles above the ionosphere (the layer of the upper atmosphere that reflects radio waves) might improve radio communication. As cloud-seeding agents, the foamed smokes have several advantages over the commonly used silver iodide crystals. They also might prove valuable as a shield to protect ground personnel from thermal radiation emanating from experimental nuclear blasts, Miss Raskin said, adding:

"Since urethane foams have good thermal insulating properties, and since the resulting smokes have unusually slow settling rates, another application could be to protect crops against low temperatures in a manner similar to that for which carbon smoke from smudge pots is now used. They also should make efficient carriers for relatively large quantities of insecticides."

The toxicity of these new smokes has not yet been thoroughly investigated, but the particle size suggests they would be filtered out by the hu-

man nose, and once the particles are well-dispersed in the air, their chances of causing physiological damage is minimized.

Fallout Resistance

➤ PLANTS resistant to radioactive cesium may help solve an important fallout problem: contaminated feed for man, cattle and other animals.

Research indicates that plants may be able to absorb certain beneficial elements and reject harmful radioactive ones, although both materials are chemically similar.

This discovery might lead to selective breeding of plants and thereby reduce the amount of deadly radioactivity available to man, Drs. Eric B. Fowler and C. W. Christenson, University of California, explained at the meeting.

Cesium-137, a radioactive form of the element which makes up about six percent of the released fission products from atomic explosions, is dangerous for about 26 years, Dr. Fowler said. Since cesium-137 can enter the human body through food, there is widespread concern about its absorption by plants.

Cesium is chemically similar to potassium, an element necessary for plant growth. Previous work showed the presence of "exchangeable" potassium in the soil, which is readily available to plants, depresses the uptake of cesium. Therefore, in the new investigations, lettuce, grass and alfalfa were grown in four soils containing various amounts of potassium and contaminated with radioactive cesium.

The most marked effect was seen in alfalfa where the available soil potassium observed in the plant increased by a factor of 8.5. Comparable calculations for lettuce and grass showed decreases by a factor of about 5.3 for both plants, the chemists reported.

The results showed that discrimination is extremely complex and "each soil and each plant must be considered as a separate problem."

Dr. Fowler said there are probably two reasons for the discrimination: "It is possible that plants are selective in feeding and preferentially utilize potassium, or perhaps the cesium is so tightly bound to the soil as to be unavailable to the plant."

He said some reaction may occur in the soil between its components and cesium, making it impossible for cesium to enter the plant.

Hero Cholesterol

➤ EXCESS CHOLESTEROL may prevent acute heart attacks and hemorrhages caused by clotting of blood.

This fatty substance, often blamed for diseases of the heart and arteries, might aid doctors by preventing dangerous blood clot formation, Dr. Herbert L. Davis, University of Nebraska, reported at the meeting.

In laboratory test tube studies, the amount of cholesterol that might be found in the blood after a heavy high-fat meal promoted clot formation, but higher concentrations retarded or prevented this dangerous condition, the biochemist reported.

Dr. Davis, who was the first speaker in a symposium on blood clotting, described research conducted in the chemistry of gelatin, soap, starch and

anticoagulant drugs in an effort to find effective ways to prevent heart attacks, strokes and hemorrhages. Gelatin, soap, starch and blood clots are examples of "gels" or coagulated solutions.

"The blood clot is the most important gel in the world, for if it does not form when needed, the person or animal bleeds to death," Dr. Davis asserted. If it forms when not needed, this same gel blocks the blood flow to areas of heart, brain or other vital organs and produces impairment or death of these tissues and possibly of the human being or animal involved." One blood clot can immobilize 1,000 grams of whole blood.

Colloids are special liquid mixtures in which very tiny particles remain suspended. Blood plasma may be regarded as a colloidal solution. Through such an approach to the problem, he observed, "it might be just possible to improve on the natural controls, or at least to supplement them."

Another chemical that is important in blood clotting was discussed at the same symposium.

The protein thrombin has been isolated in virtually pure form and made available for research, Dr. Walter H. Seegers, Wayne State University, reported.

Thrombin is a clotting enzyme found in human blood in an inert form called prothrombin. How the inert form may change to thrombin represents some of the most complicated chemistry ever encountered in life processes.

Co-authors with Dr. Seegers were Dr. Gerardo Casillas, Dr. Robert S. Shepard, William R. Thomas and Dr. Paul Halick.

Tumors Reduced

➤ A POSSIBLE means of reducing cancer tumors was announced.

A rare cancer tumor called chloroma can be made to disappear by the action of the anti-leukemic agent, thio-tepa. Dr. Julius Schultz of Hahnemann Medical College, Philadelphia, has conducted studies to discover what factors in the tumors can make the same agent effective against more prevalent tumors.

Chloroma is exceptionally rich in unbound porphyrins, so these seemed favorable factors to test, Dr. Schultz told Science Service.

Porphyrins are organic compounds of extreme importance in the maintenance of both animal and plant life. They are bound to proteins in the form of cytochromes, the enzyme systems essential for respiration in all living cells.

When modified, unbound porphyrins showed marked inhibitory actions on the cytochromes of an induced tumor in rat liver. Thio-tepa could then considerably decrease the size of the tumor, Dr. Schultz said.

The modified unbound porphyrins made the cytochromes in the rat tumor similar to those in chloroma, thus explaining the induced regressive effect of the thio-tepa.

Other factors which make chloroma sensitive are also thought to be involved. What role these factors play in the regressive process initiated by thio-tepa is now being studied, Dr. Schultz said.

Special Section on Wood Chemistry

Chemicals from Trees

Based on a Speech by
Dr. A. K. Esterer, a Project Scientist for Weyerhaeuser Timber Co.

➤ THE CHEMICAL utilization of the tree has developed in the United States into an industry producing at an annual rate in excess of $111,000,000. If the manufacture of chemical pulp from wood is included, the figure is far greater. Steady progress is being made in improving existing processes and products, but there is considerable room for expansion.

The breakdown of wood to chemical pulp is by far the largest wood chemical industry. Progress is evident in the wider use of continuous pulping, and in the introduction of new processes. Pulp and paper is discussed in detail later.

Wood distillation or pyrolysis is most prevalent in the widespread use of charcoal for outdoor cooking.

Wood hydrolysis yielding sugars and lignin, is being investigated, but no plants seem to be operating except possibly in Soviet Russia.

The breakdown of wood through hydrogenation or biological means is still confined to the laboratory stage.

Trees contain a large number of chemical compounds and are an excellent source of raw material for chemicals. These include aliphatic chemicals, aromatic chemicals, crystalline and non-crystalline compounds, some in large percentages, and some in traces. They can conveniently be divided into four groups: wood or extractive-free lignocellulose, bark, foliage and extractives.

Wood constitutes by far the largest part of the tree. It is at present practically the only part which is completely used commercially. Wood is a structural polymer in which cellulose fibers are ingeniously cemented together by "lignin" and probably hemicellulose, in a way similar in principle to modern glass-fiber reinforced plastics.

Mysterious Lignin

Approximately 10% of the tree substance is the protective sheathing known as bark. The barks of most tree species have been analyzed chemically and as a general pattern, consist of lignocellulosic fibers, water-soluble phenolic compounds (tannins), phenolic acids, and extractives, such as wax. The larger part of these components seems to be chemically combined. The composition of bark varies for different species and the percentage of constituents varies from tree to tree. Lignin is still much of a mystery. It is not even known yet whether in its natural state it is a low or high molecular weight compound, nor whether it is a polymer with a recurring building block, and if so, what the building block is.

Foliage seems to have attracted research efforts only to a small extent so far. Chlorophyll, starch, cellulose, and aromatic oils are the chemicals known to be present but others might be found. Problems of collection and transportation would have to be

solved if foliage was to be efficiently utilized.

Although extractives are not physically separate component parts of trees, it is useful to list them separately because they form a large group of specialty chemicals which can usually be separated from the tree components by simple physico-chemical means, usually extraction.

Some of these specialties are now being made synthetically, such as camphor and some grades of wax, others are recovered from wood or bark of trees, such as rosins, tall oil, cascara, and more recently, quercetin, a yellow crystalline dye.

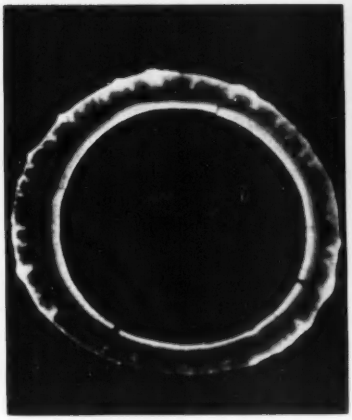
Hypodermic for Trees

➤ THE FIRST TREES to have received planned injection with radioactive carbon were felled late last year. The initial results indicated a "strong possibility" for higher future yields of cellulose per tree, ("even doubling or tripling the current cellulose output per acre") plus improved cellulose quality for such large consumers as the rayon tire cord and cellophane industries.

Attendant benefits such as better reactivity, greater production efficiency and lowered costs were also forecast by Dr. R. L. Mitchell of Rayonier, Inc.

At their research center, scientists using ordinary hypodermic syringes injected radioactive carbon (C-14) into young pine trees for the world's first controlled experiments in the study of cellulose growth in living trees.

Dr. Mitchell reported that the cellulose subsequently "laid down" in the test trees was "definitely labeled." The sharpest radioactivity was found near the cambium, the soft tissue just under the bark within the ring of cellulose corresponding to last season's growth. Some radioactivity also showed up in rings one and two as well as in the bark, indicating diffusion or possibly that limited growth activities continue in older sections of a living tree.



➤ AN AUTORADIOGRAPH *on marked X-ray film shows how radioactive carbon (C-14) tags growth inside a tree. (Picture is magnified about 10 times.)*

The trees used in the study were 2-year old pines, now a major replenishable source of quality cellulose, he said.

Rayonier scientists have completed

➤ THIS TREE *is being made "hot" with radioactive carbon (C-14). Wearing rubber gloves for protection, a Rayonier scientist injects C-14 into a young pine tree with a simple hypodermic syringe.*

the dissection of one of the "hot" trees and are now using the various tagged components from bark, lignin, cellulose and the hemi-cellulose, for further studies.

Dr. Mitchell revealed that cellulose in quality suitable for high tenacity rayon has been isolated from the radioactive portion of the tree for further laboratory investigation, particularly in connection with viscose process mechanisms.

Rayonier's original purposes for injecting radioactive materials into trees were primarily for the exploratory study of wood growth factors, nutriena uptake and to provide tagged materials for experiment in cellulose chemistry as related to end products.

At that time it was not established whether a tree's numerous chemical components could be successfully labeled with C-14 while under conditions of natural growth. Dr. Mitchell declared the first results "erased all such doubts."

Technical Advances

He noted that continuing studies with radioactive trees should "throw

new light upon several unknowns" in both cellulose chemistry and silvichemistry, and eventually result in new technical and product advances.

Dr. Mitchell asserted that the radiation in the felled trees, although relatively intense, is of soft "beta" nature. He added that there is little or no danger involved in handling the "hot" material.

However, all radioactive wastes are carefully collected, placed in special radiation-proof containers and delivered to an agency of the Atomic Energy Commission in New York for final safe disposal.

Chemicals in the Paper Industry

➤ THE PRODUCTION of pulp and paper has increased 850 per cent in the past 50 years, and is now the fifth largest industry in the United States. Backed by modern tree farming practices on company and other private woodlands, together with increasing use of sawmill slabs and edgings and the use of more hardwoods, the supply of raw material seems assured. There is every indication that paper will continue to serve man in new and old ways.

Wood Pulp

The several processes for making wood pulp are very much alike in principle. All wood is made up of the same basic parts: cellulose fibers, a glue-like binder called lignin which holds those fibers together, plus sugars, gums, resins and mineral salts in lesser quantities. The task of the pulp manufacturer is to separate the fibers and to rearrange them in new patterns and combinations with other substances to make different products. This may be done either mechanically or chemically. The method chosen depends upon the type of wood used and the requirements of the end product.

The following is condensed from *The Story of Pulp and Paper* published by the American Forest Products Industries, Inc., 1816 N St., NW, Washington 6, D. C.

First, bark must be removed from the logs. Sometimes this is done by hand labor in the woods where the trees are cut. More often it is done at the mill where bark is removed by tumbling the sticks against each other in barking drums or by applying high pressure jets of water that literally blast the bark away.

Mechanical Pulping

In plants using the mechanical pulping method to make what is called groundwood pulp, sticks are reduced to fibers by huge, rough-faced grinding stones. Since lignin is not removed, papers made by this method do not generally keep their brightness and strength as long as papers made from chemical pulps. However, groundwood paper has certain qualities desired for various printing processes. Paper on which newspapers are printed consists largely of groundwood pulp. So are the lower grades of tablet paper and other papers which do not require unusual strength or are intended to be used only a short time.

Chemical Processes

In the chemical paper-making pro-

cesses, wood fibers are separated from their lignin binder by cooking in any one of several chemical solutions. The most common are sulphite (an acid calcium bi-sulphite solution); soda (an alkali caustic soda solution); or sulphate (a modification of soda with sodium sulphide). Special sulphite and sulphate pulps, called dissolving pulps, are used in the manufacture of cellophane, explosives, plastics, and rayon.

Paper made from hardboards through the soda process is noted for its fine texture and printing qualities. Hardwood fibers are much shorter than softwood fibers. When pulped by this process and mixed with longer fibers, they make high quality magazine and book papers which are well adapted for reproduction of photographs.

Originally the sulphate process was used mainly for the pulping of softwoods, especially pine. Now the process is used in pulping both softwoods and hardwoods for kraft papers, which are used for wrappings, grocery bags and other durable papers requiring strength. Envelopes for heavy mail, corrugated board and tag stock are among the many paper products made from sulphate pulp. In recent years the uses of this pulp have been broadened to include tissue, writing, printing and many other kinds of paper, including bright white grades.

Semi-Chemical Processes

Another way of making wood pulp which combines mechanical and chemical methods is called the semi-chemical process. It was developed particularly for the pulping of hardwoods and has many variations. The pulpwood chips are cooked in a mild sodium sulphite or sulphate liquor. Semi-chemical pulps produce stiff, resilient products and are used in making corrugated paperboard, egg cartons and other items.

In each of the chemical methods, pulpwood sticks must be chipped before they are cooked. Rotating knives slice across the logs, cutting off chips from $\frac{3}{8}$ to $1\frac{1}{8}$ inches long and about $\frac{1}{8}$ of an inch thick. An endless conveyor belt carries them to storage above chemical cooking vats, called digesters.

Cooking

These digesters operate on the same principle as a kitchen pressure cooker. Wood chips in chemical solution are cooked with steam until reduced to a wet, pulpy mass. It is this cooking which dissolves the resins and glue-like lignin and separates the fibers.

No matter which of the processes just described are used, wood pulp requires additional treatments—washing, screening and sometimes bleaching—before it can be made into paper or other products.

Washing removes leftover chemicals and non-fibrous substances. Screening removes dirt, uncooked or unbroken pieces of wood, and separates fibers according to size. Bleaching gives pulp the desired degree of whiteness and also further purifies it.

All the processes described thus far take place in the pulp mill, of which there are 340 in the United States. If the pulp is not to be used immediately, much of the water is removed. Then the pulp can be cut into thick rectangular sheets, and baled for storage or for shipping to one of the na-

tion's 800 or more paper mills or to mills making other pulp products.

Paper From Pulp

Some paper mills have their own pulp mills from which a constant supply of pulp is received. Others get shipments of pulp by rail or truck from distant points, even by ship from other countries. In the paper mill the first step is to mix the pulp with water in a large tank called a beater. Many paper and paperboard products are made by combining two or more kinds of wood pulp. Newsprint, for example, is made chiefly of groundwood pulp, but chemical pulp is added to give additional strength. During the beating process, the diluted pulp passes between sets of metal bars or knives which rub against the fibers. Rubbing and cutting separates the fibers, reduces them to proper length and frays edges and sidewalls to some extent so that, when water is drained from them on the paper machine, a uniform sheet of paper will be formed. The sets of knives can be adjusted to turn out longer or shorter fibers with rougher or smoother edges, depending upon the kind of paper to be made. During the beating process, color, size and filler are added as needed.

Sheets of Paper

The pulp is now ready to be made into paper. It goes from the beater into a storage chest from which it is fed onto the Fourdrinier. The pulp, as it is run onto the endless wire mesh screen, is about 99 per cent water and looks like milk. The endless wire screen has as many as 6,000 tiny holes per square inch. Constant side-to-side vibration of the screen causes the cellulose fibers to become interlaced. In the process much of the water is drawn off, leaving a very wet sheet of pulp. It is further dried by suction which pulls water down through the screen into tanks below.

Many paper board products are made in cylinder machines. Wire-covered cylinders revolve in vats containing fibers suspended in water. The fibers collect on the screen as the water flows through. Using a number of cylinders, a multi-ply sheet is formed.

From the screen, the wet sheet of pulp passes to a belt of wool felt which carries it through many pairs of heavy rollers. These rollers press out more water, and the felt absorbs much of the remaining moisture.

Now strong enough to sustain its own weight, the fast-moving sheet leaves the woolen felt and enters the dry end of the paper machine. Here it travels through a long series of rotating, steamheated iron cylinders, called driers. This series of rollers may be as short as 20 feet for cigarette papers, or as long as 350 feet for some types of heavy wrapping papers. Paper moves over these rollers at high speed, some times as fast as 2,600 feet per minute (30 miles an hour). Some machines are wide enough to handle paper up to 25 feet across. On these drying rollers, nearly all the water is removed.

Finishing

Most papers go through one or more additional processes, one of which is calendering. This consists of ironing the paper between heavy, polished steel rollers, giving it a much smoother surface.

For linen finish, cut paper is piled with linen cloth between sheets so

that the design of the cloth is pressed into the paper. However finished, when the product comes off the dry end of the machine, it is paper—made from trees.

Some paper is wound in large rolls as it comes from the calenders. These are later rewound or cut into smaller rolls or sheets as required by the customer. Some papers are produced specially for further processing by converter plants, which make paper into milk containers, grocery bags, paper cups and many other products.

Paperboard is made in much the same way as paper. Paperboard is used for cartons, folding boxes for frozen foods, and many other items. Quite a bit of the pulp for some types of paperboard is made up of re-pulped waste paper from which ink and other impurities have been removed. In fact, over one-fourth of the fibrous raw material for all U. S. paper and paperboard production is waste paper.

New Products

With a wide variety of pulp grades, strengths, colors and fiber lengths available for blending in many combinations, more new products constantly are being added. By treating with wax, asphalt, polyethylene, starch and other materials, more moisture-proof papers are being made, including more paper containers for liquids. Paper is being equipped to do more and more jobs which formerly only wood, glass, leather, and cotton could do. In addition the chemical industry is constantly finding new uses for the spent liquors left over from the chemical pulp processes. They are used in making adhesives, road binders, tanning agents, plastics, dyes, rosin soap, acetic acid, turpentine, fertilizer, and many other products.

Glossary

Bleaching — The process of purifying and whitening pulp. Chlorine, peroxides, and calcium hyochlorite are most generally used to bleach chemical pulps. For groundwood pulp, sulphur dioxide and sodium peroxide are used.

Color — Dyes added to wood pulp to give the finished product the desired color. Dyes must be weighed accurately and handled with care as they may account for as much as 50 per cent of the coat of the finished sheet of paper. Usually two or more colors are needed to get the desired shade.

Filler — A substance added to pulp in paper manufacture to fill the spaces betweeen wood fibers. This makes a firmer, smoother sheet of paper, and one which is more opaque.

Fourdrinier — The wire part of a paper-making machine, where the wet sheet of paper is formed from liquid pulp. Most paper-making machines are nearly a city block long and have two other main parts: the press part which makes the wet sheet of paper firm by pressure and suction, and the dry part which dries the paper by passing it over heated rolls.

"Sawdust" in Paper

➤ A NEW TYPE of sawdust soon may be used in the manufacture of pulp and paper. It has been done already on a pilot scale in south Georgia.

There is about one ton of sawdust for every thousand board feet of lum-

ber produced. No important or large use exists for it.

A modified type of sawdust or "saw kerf chips," however, now comes from a new type of saw blade developed by J. T. Griffin, an Atkinson County lumberman.

This revolutionary saw blade has about one-fifth the number of teeth found in conventional saws. Each tooth takes a large bite. Hence chips of pine rather than "dust" is the result.

The fiber length of chips is long enough for utilization in the pulp and paper process. And in all the tests he has made, the lumberman reports, the new type of saw cuts no wider kerf or gap than conventional saws.

Rigid laboratory tests and evaluation in the next few months are expected to decide the feasibility of wider application of the process throughout the sawmill industry.

All aspects, technical and economic, of the chip process at sawmill level are to undergo testing at the U. S. Forest Service's Forest Products Laboratory, Madison, Wis. Rayonier, Inc., is making the first production runs with the chips in its Fernandina Beach, Fla., mill.

An entire carload of pine logs, both peeled and unpeeled, has been shipped to the Madison laboratory. Mechanical limitations are to be tested as well as the physical character of the chips and net value of the product.

Faster Molybdenum Powder

➤ A NEW PROCESS for the production of molybdenum metal powder is said to produce the powder five to eight times faster than current methods.

Molybdenum is a refractory metal finding increasing uses in the expanding atomic, missile and other high temperature fields.

The process, invented by Lester D. Supiro of East Orange, N. J., and announced by Metals and Residues, Inc., makes molybdenum powder by a rapid, single-stage reduction of molybdenum oxide at high temperatures. Because of its extreme volatility molybdenum oxide is now mainly reduced in two stages.

Mr. Supiro's process is claimed to be superior to older processes in offering greater speed and economy of energy. It also affords higher recoveries and a powder of higher purity.

"Molex" Promises Better Auto Fuel

➤ A NEW OIL refining process called "Molex" promises more efficient fuel for American cars.

Molex, developed by Universal Oil Products Company, and described to the Western Petroleum Refiners Assn., removes low octane ingredients from gasoline mixtures by means of crystals that permit long, slim, low octane molecules to pass through. They stop chubby, forked molecules — those with high octane value. Molex will raise octane numbers of top premium gasoline to 105 as opposed to the current 102. The fuel also should give better performance under stop-and-go conditions.

Gout – The Mystery Disease

by Helen Buechl

➤ If the falling apple that inspired Isaac Newton had hit him on the big toe, the great physicist might have been remembered today as a great medical man instead.

For it is reputed that Isaac, along with Alexander the Great, Benjamin Franklin, Martin Luther, John Calvin, and Francis Bacon suffered from the gout.

However, the apple did not hit Isaac's gouty toe. Instead, daring Isaac concentrated on the apple, not his toe, and forged ahead, developing the concept of gravity. In fact, he was so successful that physicists still cling to the Newtonian laws.

Medical Mystery

Meanwhile, as Isaac pondered, people continued to suffer from gout. As a matter of fact, they still do — to the tune of about 300,000 today in the United States alone. The ache in the big toe was a medical mystery in Newton's day. Developing the laws of gravity lent little therapeutic aid to this arthritic disease.

Gout remains the mystery it was those many years ago. Doctors know only that it is a defect in the body's chemistry that can lead to an arthritic condition.

This abnormality causes increased deposits of uric acid in the blood and tissues. These pop out in the form of lumps, usually on the big toe. They may also appear around almost any joint. The deposits, large masses of chalky salts of uric acid, are themselves, painless.

Then why all the fuss from gout victims? Because the joint upon which the lump forms becomes inflamed and very painful. Also, since uric acid is normally excreted by the kidneys, these vital organs occasionally become damaged and uric acid kidney stones form.

Saffron Remedy

But the picture is not quite as bleak as one would be led to believe. Nature has provided gouty man with several lump-ache remedies. Granted, they are not guaranteed to eliminate the cause, because little is understood or known about the disease.

One such remedy is a drug called colchicine. It is widely used by doctors today to ward off or treat current attacks and prevent their recurrence.

This drug is extracted from the bulbous root and seeds of the meadow saffron, a pink or purplish wildflower that blooms in the fall. It was discovered by the Greek physician, Alexander of Tralles, in 550 A.D. Although colchicine has been used since antiquity, its action is still not understood.

The drug was introduced to this country by Benjamin Franklin who had a very bad time with gout and who had heard of colchicine treatment during his stay in France.

In spite of treatment with this drug, uric acid salts may continue to be deposited in a slow, insidious fashion in the body's tissues.

But now, researchers have stumbled upon a drug that exhibits powerful

anti-gout properties. The drug itself, zoxazolamine, is not new. Doctors have been using it for several years as a muscle relaxant.

Zoxazolamine's anti-gout action was discovered as the result of a chance observation made during studies of the drug's metabolic breakdown in the body.

Dr. J. J. Burns of the National Heart Institute, Bethesda, Md., and his co-workers were studying the biochemical fate of zoxazolamine in the body when they noticed large amounts of a white crystalline compound accumulating in the urine of patients receiving the drug as a muscle relaxant.

Acid Crystals

Chemical analysis revealed that they were actually crystals of uric acid. It was this observation, made by Dr. Burns and his associates, Drs. T. F. Yu and Alexander Gutman of Mount Sinai Hospital and Dr. Lawrence Berger of Goldwater Memorial Hospital in New York, that gave the first clue to the drug's powerful anti-gout properties.

Preliminary tests on gouty patients indicate that the drug removes the uric acid more successfully than any uricosuric drug now used. Studies to date indicate that the drug is approximately six times more potent than any other drug of this type now available.

Although greater potency alone is not always significant (less potent drugs can often produce the same effect as that from more potent drugs) the important advantage of zoxazolamine is that its maximum effect is greater than any that can be produced by other drugs.

The medicine chest for the treatment of gout also includes adrenal steroids, ACTH, butazolidin, aspirin and Benemid, the drug most commonly used to overcome and prevent this accumulation of uric acid in the body.

Most attacks of gout occur without any apparent reason. Furthermore, an attack of gout is not necessarily coupled with an increased level of uric acid in the blood stream. Doctors still do not know the exact relationship, if any, between metabolism and gout. A high uric acid level in the blood is not in itself an indication of gout.

It has been common belief for centuries that gout was the result of "high living" — eating rich foods and drinking too much alcohol. In the 18th and 19th centuries, the disease became a symbol of self-indulgence.

The medical world now knows that gout is not the result of such indulgences. Yet, one aid to the successful control of gout attacks is a regulated diet. One class of foods does cause a markedly increased level of uric acid. These are the foods rich in purines. They include sweetbreads, anchovies, sardines, kidneys, brains, liver and meat extracts.

But the most important point to remember concerning diet is the slim figure. In other words, avoid becoming overweight which can make gouty attacks more common and severe.

Inheritance Possible

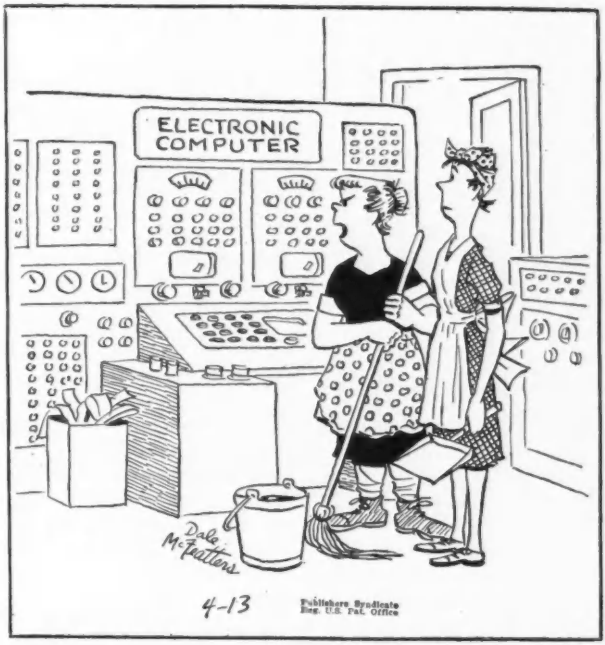
Some scientists suspect that gout is hereditary. It usually affects men between the ages of 30 and 50. It is

rarely found in children, or in women before the menopause.

Even parakeets are known to suffer from gout. They develop lumps on their legs.

Today, many research studies underway are seeking answers to the mysteries of this disease. New leads are being developed in laboratories around the world. Here in the United States, studies of this kind are supported by the National Institute of Arthritis and Metabolic Diseases at Bethesda, Md., and the National Institute of Arthritis and Rheumatism Foundation of New York.

These studies are aimed at providing a more effective drug than colchicine in order to prevent and treat acute attacks. Luckily, Dr. Burns and his co-workers stumbled upon this new application for the well known drug, zoxazolamine. Further tests with this drug may place it at the top of the list as a chemical aid in the treatment of gout.



"I still say there's people inside!"

Fallout and Public Health

➤ THE FEDERAL Government protects us against the farmer who would like to use chemicals to rid his dairy cows of insect pests, but who or what is protecting us against contamination from radioactive fallout?

This is the problem facing scientists, health officials, Congressmen and the public.

Official Government rulings make it clear that no chemical can be used if its use leaves any harmful residue in milk. Studies have been made and standards of tolerance, with a "zero tolerance" for milk, when it comes to possible chemical contamination of milk, water or food have been set.

Now someone has to decide just how much radioactive contamination the public can "tolerate" and how these radiation safety standards can be enforced.

There is mounting evidence that radioactive fallout is not only a problem to be dealt wtih in the future, but is affecting the public health today. High contamination levels in wheat and milk have been found. As a result there is an added urgency to attempts to set standards such as the maximum permissible radiation dose for fallout products like strontium-90.

Currently a committee is studying the possibility of giving the Public Health Service responsibility for setting and enforcing radiation safety standards. According to some scientists and Government officials, the Public Health Service would be the logical agency to carry on these activities.

The PHS, through its division of radiological health, is already involved in radiation safety. It maintains a national surveillance network of water, air and milk, cooperates with other agencies in radioactive protection methods and has a program of educating the public and others concerning the problem of radiation. The Taft Sanitary Engineering Center in Cincinnati, Ohio, is also working on some related engineering problems, such as instruments for detecting radiation and improved methods for decontaminating radioactive waters.

Fallout Danger

➤ THE INVISIBLE RAIN of radioactive particles from H-bombs exploded by the U. S. and Russia is increasing in intensity each year, figures prepared by Atomic Energy Commissioner Dr. Willard F. Libby show.

Because the biological effects of the increasing fallout on the world's population are largely unknown, "care and caution" must be taken in adding to radioactive contamination of the atmosphere, Dr. Libby reported in a speech at the University of Washington, delivered in his absence by Dr. J. Calvin Potts, special assistant.

Dr. Libby predicted that the major questions concerning how and when fallout occurs will be answered by measurements made during the next weeks and months, but the "tremendous problems" of biological consequences will remain. Therefore, fall-

out should be watched and controlled as carefully as possible.

Dr. Libby believes that the radioactive material introduced into the earth's high atmosphere, or stratosphere, when H-bombs are exploded, mixes rapidly, then leaks down uniformly over the world. This fallout each year is 16% of the total accumulated in the stratosphere and seeps into the troposphere, about the first 40,000 feet of atmosphere. Radioactive debris is removed from the troposphere in about one month by normal weather processes and by striking the surface of trees, grass and other features.

A "tremendous rise" in fallout rate ocurred in October, 1958, Dr. Libby found, due to the Russian test series in the polar regions. Measurements after those tests and the U. S. ones of the Hardtack series in which special isotopes tungsten-185 and rhodium-102 were added, will show the mechanism by which the fallout reaches the earth's surface.

Dr. E. A. Martell of the Air Force Cambridge Research Center suggests the increases in fallout rate that have occurred each spring for several years are due largely to Russian tests, which have spewed debris into the lower and intermediate levels of the stratosphere where the radioactive materials remain only about six months. The measurements now being made will show whether this theory is true, and they may also show how much the Russian tests have contributed to world-wide fallout.

Dr. Martell's theory will be reported in the journal, *Science*, according to Dr. Libby.

Nerve Research With Eels

➤ THE PROCESSES of human thought are being studied with the aid of electric eels.

Electric eels, called "nature's gift to the biochemists," Dr. David Nachmansohn of Columbia University's College of Physicians and Surgeons explained, "offer an enlarged reproduction of the human nervous system where electrochemical phenomena are greatly amplified and so easier to study." It is the fish's large supply of cholinesterase that holds the key to the studies of the nervous system.

Although all nervous systems expend electrical energy by means of the protein cholinesterase, eels discharge as much as 600 volts compared with the one-tenth of a volt discharged by man. Man uses this small voltage in conducting nerve impulses through the body to the brain; the electric eel uses his voltage to stun his prey.

The studies conducted by Dr. Nachmansohn, his associate Dr. Irwin B. Wilson and other Columbia researchers have already resulted in the discovery, in 1956, of an effective antidote for nerve-gas poisoning.

Experiments with the cholinesterase from the eel's electric organs led to the design of the antidote PAM.

However, Dr. Nachmansohn describes PAM as a by-product of a broad basic research project directed at discovering the nature of thought to the workings of the nervous system.

Russia May Lead Nuclei Studies

➤ RUSSIA may overtake the United States in the discovery of new elements and study of heavy nuclei, a basic science area in which America has been dominant.

This was suggested by Dr. Glenn T. Seaborg, Nobel laureate at the University of California, who has taken part in the discovery of nine out of ten transuranium elements, including plutonium, element 94.

Dr. Seaborg was officially inaugurated as chancellor of the Berkeley campus March 20. At the University's faculty research lecture, he said the Russians are building an ultra-high flux research reactor, which is a key to studies of the very heavy elements. No such reactor has been authorized in this country.

Object of such a reactor is to produce an enormous barrage of neutrons, duplicating in a modest way conditions of super novae and hydrogen bombs. Uranium atoms can capture a number of neutrons and be "fattened up" to become heavier atoms. Milligram quantities of californium, element 98, could be produced; this is a huge quantity in terms of this element.

Such quantities of californium would provide a better target for bombardment with heavy nuclei in the Hilac accelerator, making possible production of elements ranging up to 104, 105 and higher. At present only invisible amounts of californium can be produced and only after years of waiting.

An ultra-high flux reactor would cost $10,000,000, generate about 100,000 kilowatts in a core of only about a cubic foot volume, and in this core generate five million billion neutrons per second per square centimeter.

Increasing competition from the Russians in the heavy element work is indicated by their discovery, said Dr. Seaborg, of an isotope of element 102. Berkeley scientists, including Dr. Seaborg, discovered isotope 254 of element 102 last year. Apparently the Russians have discovered isotope 253, although identification is not yet certain.

Irradiated Food in Russia

➤ THE RUSSIAN housewife can purchase potatoes that have been preserved by irradiation. American housewives cannot.

The Russians are first on the market with irradiated food, according to the March Public Health Reports, issued by the U. S. Public Health Service.

Yet, the U. S. is miles ahead of Russia in research with various types of irradiated food, Dr. R. G. H. Siu, technical director of research and engineering, U. S. Army Quartermaster Corps, told Science Service.

Researchers in the U. S. are feeding irradiated foods to several generations of several species of animals to observe what effects, if any, are due to this method of preservation, he explained.

The researcher predicted that it will

be at least two years before irradiated foods find their place on grocery shelves. The Food and Drug Administration stamps final approval on all foodstuffs.

Until scientists can prove to FDA and themselves that there is no slightest possible harmful effect from the process, irradiated food will remain a novelty.

The U. S. has irradiated potatoes (inhibiting their sprouting ability), meats, vegetables and milk. Potatoes require a low dosage of treatment, 10,000 rads. A rad is the amount of energy required per gram of foodstuff, Dr. Siu explained.

On the other hand, meats, such as roasts of pork and beef, require between 2,000,000 and 4,000,000 rads. The day may come when the housewife can pick a cellophane-wrapped, irradiated roast from the grocery shelf, not refrigerator, pop it into the oven to warm up, and serve just as she now prepares the "brown and serve" rolls.

All of this research is not directed just at the housewife, either, Dr. Siu said. The men who will eventually fly in space capsules will need food supplies.

It is not inconceivable that they will carry irradiated Southern fried chicken on interplanetary journeys. And it will taste like Southern fried chicken, Dr. Siu promised.

Irradiation protects food from harmful bacteria by killing the organisms. Some of the nutritive value of some foods is destroyed in this process. This amounts to no more, and in some cases, less than that lost by conventional canning methods now used, he said.

"Laminated" Ceramic-Metal Material

➤ "LAMINATED" ceramics and metals offer a new approach to the problem of making a heat-resistant material suitable for missile cones or jet engines of the future.

Attempts to combine ceramics and metals, strongly encouraged by the Air Force since World War II, have so far been concentrated on joining the individual particles of ceramic and metals, somewhat like mixing salt and pepper. The results have been generally unsatisfactory.

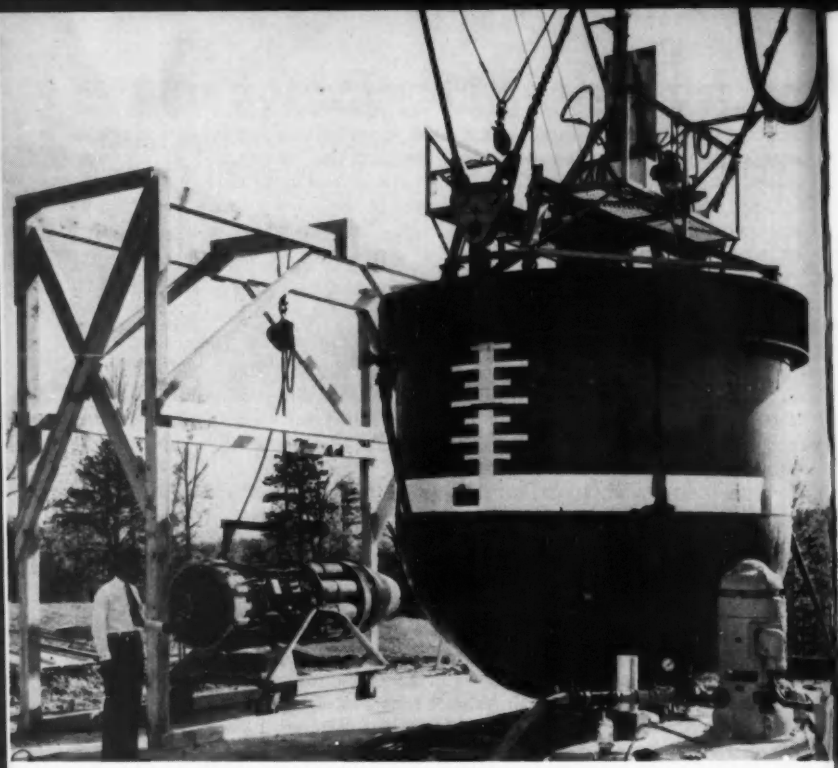
Under the new concept evolved by Prof. Francis R. Shanley and William J. Knapp of the department of engineering at the University of California at Los Angeles, molten metals and ceramics are first flame-sprayed in alternate thin layers on a rotating disk.

After cooling, the layer "cake" is crushed into small grains, with each grain retaining the laminated, or layered, ceramic-metal structure. The grains are then hotpressed in a graphite mold at temperatures of up to 2,200 degrees Fahrenheit.

The resultant ceramic-metal, or cermet, material resists both extreme heat and pressure.

The mixture is considerably less brittle than ceramics, because the metal layer provides "slippage" for the ceramic layer.

The two UCLA engineers hope that ultimately the laminated cermet mixture, besides its military potential, will have numerous civilian uses, especially for load-bearing structures exposed to very high temperatures.



➤ A General Electric *Company health physicist, F. G. Boyle, monitors a J-47 aircraft jet engine which has been irradiated by a test reactor at the Atomic Energy Commission's Oak Ridge National Laboratory.*

This engine later was disassembled to learn the source of most residual radiation. John Moteff, General Electric expert on induced radiation, recently reported that the bulk of this activity was caused by manganese, sodium, and tantalum, with activity beyond two or three days domniated by the tantalum isotope.

Three years after irradiation, only slight traces of cobalt activity were detectable, Moteff said.

These tests were carried out by General Electric's Aircraft Nuclear Propulsion Department (ANPD) located at Cincinnati, Ohio. General Electric operates ANPD under contracts with the AEC and the U. S. Air Force. The tests are conducted to determine if various materials should be eliminated from the nuclear propulsion system to reduce handling problems.

Another In Series on Chemical Organizations

Association of Agricultural Chemists

➤ THE ASSOCIATION of Official Agricultural Chemists, more familiarly known as the AOAC, is the professional organization of State and Federal chemists devoted to developing, testing, and sponsoring improved methods for the analysis of fertilizers, soils, foods, feeds, pesticides, drugs, cosmetics, caustic poisons, and other materials related to agricultural pursuits. It was organized in 1884 by the State and Federal chemists who were in charge of enforcement of State fertilizer laws, or who, as members of agricultural experiment stations or the U. S. Department of Agriculture, were interested in practical and scientific applications of fertilizers to crops.

Voting Restricted

The form of organization is one in which voting is restricted to official chemists, but discussion is open to all chemists. Four meetings prior to 1884 had failed to produce a cohesive and stable organization of both official and commercial chemists. This final organizational form was settled upon with the full cooperation and even insistence of commercial chemists. They agreed on the principle that since it was the official chemists who had the responsibility for the enforcement of the laws, they also had the responsibility for the choice of valid methods of analysis for this purpose.

As the regulatory control of other commodities such as foods, feeds, drugs, cosmetics, caustic poisons, and pesticides became a recognized governmental function, the work of the Association expanded. It has accepted the responsibility of providing the regulatory scientist with accurate and reproducible methods of analysis that are required for the enforcement of laws and regulations. This is accomplished through adherence to a fundamental constitutional requirement that methods approved by the Association be subjected to collaborative study. In this, a number of representative chemists analyze the same samples by the proposed method to demonstrate its accuracy and reproducibility in their hands.

Associate Referees

At the present time about 250 chemists, designated as "Associate Referees," are studying methods of analysis grouped in about 50 general categories from "Agricultural Liming Materials" to "Waters." Not all of them are official chemists; many are industry chemists, who because of their specialized knowledge and experience, also participate in the development and testing of methods of analysis. The results of the studies of these Associate Referees form the basis for the actions of the Association in its approval or disapproval of methods.

All State chemists including those of universities and experiment stations are members of the Association. Federal organizations represented in the Association are: Food and Drug Administration, Public Health Service,

Department of Agriculture, Department of Defense, Internal Revenue Service, and National Bureau of Standards.

The laws enforced by the AOAC members require objective, scientific evidence for their successful application.

The AOAC attempts to provide for both industry and government a common meeting ground for discussion, at a scientific level, of methods of analysis that will be used to obtain this evidence.

That this has been successful is indicated by the facts that some State laws specify the use of AOAC methods, where applicable; the Federal Definitions and Standards of Identity for many foods incorporate AOAC methods into their requirements; many Federal specifications and private contracts utilize AOAC methods; and AOAC methods have been quite generally accorded a preferred status in court testimony. Most important of all, the general recognition of AOAC methods removes from the realm of controversy the scientific question of relative validity and merits the available methods of analysis. This is settled by the scientists themselves on the basis of the facts developed during their collaborative studies.

Publications

Results of 73 years of work by the members of the Association are embodied in its primary publication *Official Methods of Analysis of the Association of Official Agricultural Chemists,* now in its eighth edition (1955). This publication is a 1000-page laboratory manual which includes 41 chapters, 90 pages of tables, and 45 pages of index. It is an authoritative source of methods of analysis for the regulatory chemist and the agricultural scientist throughout the world.

It is supplemented by the quarterly Journal which publishes the transactions of the Association, including the annual changes in methods adopted by the Association, the reports of the Referees, and contributed papers containing new methods, new applications, and authentic or interpretive data.

Analysis Only

The Association deals only with methods of analysis. Matters involving legislation, definitions, administrative policy, and interpretation of laws are dealt with in related Official organizations: The Association of Food and Drug Officials of the United States, Association of American Fertilizer Control Officials, Association of American Feed Control Officials, and Association of American Pesticide Control Officials.

The AOAC maintains formal and informal cooperative arrangements with other scientific societies dealing with methods of analysis to maintain uniformity.

Among these are the American Public Health Association (Standard Methods for the Examination of Dairy Products), American Oil Chemists' Society (Nitrogen, Fats and Oils), American Society of Brewing Chemists (Malt Beverages), Joint Committee on Uniformity of Methods of Water Examination (Waters), and American Society of Enologists (Wines).

√ *Chemistry Quiz* √

Directions: Mark within the parentheses corresponding to the answer you think is *most nearly correct*. Answers are on page 39.

A. Which of the following words or phrases does *not* characterize the compounds, n-butane and isobutane?
( ) 1. colorless gases
( ) 2. compounds of carbon and hydrogen
( ) 3. different substances
( ) 4. isotopes

B. In the Hall process for the electrolysis of aluminum, which of the following substances is used as the electrolyte?
( ) 1. bauxite
( ) 2. cryolite
( ) 3. sodium fluoride
( ) 4. sulfuric acid

C. Which of the following minerals is *most* easily scratched?
( ) 1. apatite
( ) 2. calcite
( ) 3. quartz
( ) 4. topaz

D. Which of the following is *least* closely related to amino acids?
( ) 1. cortisone
( ) 2. fibrinogen
( ) 3. insulin
( ) 4. thyroxin

E. Which of the following is *least* likely to be used in indigo dyeing?
( ) 1. indigotine
( ) 2. leuco white compound
( ) 3. purple scale
( ) 4. zinc vat

Complete copies (with answers and norms) of many previous Science Talent Search examinations are available at 10c each from Science Service, 1719 N St., N.W., Washington 6, D. C.

Purer Folic Acid

➤ A NEW METHOD has been developed for producing pure folic acid, a vitamin important in the treatment of some anemias.

Commercial folic acid has numerous impurities, Drs. Warwick Sakami and Robert Knowles, biochemists of Western Reserve University School of Medicine, have reported in *Science*. These impurities have an "intense effect on certain enzymes" in the body, they explained.

A completely pure product, according to some established standards for purity, resulted from a process combining cellulose chromatography and filtration.

First, the scientists reported, a solution of commercial folic acid is added to a test tube containing mostly cellulose powder. The partially purified folic acid that is "washed" through the tube is then filtered through charcoal. After further treatments, a pale yellow powder is obtained that is "pure" folic acid.

Science Talent Search
Project Report

Electrolysis of Organic Compounds

by MICHAEL E. KLOTHE, *Andrew Jackson H. S., Jamaica, N. Y.*

Given Honors in the 18th Science Talent Search

➤ IN SURVEYING the chemical industry I have noticed that the production of many valuable inorganic compounds is dependent upon electrolytic processes. This caused me to think about the manufacture of organic compounds and to wonder why electrolysis is not used more in their commercial production. In fact, I become curious about the process of electrolysis itself as applied to organic compounds. In searching the literature, I found, here and there, brief mention of the electrolysis of certain organic compounds, of some mixtures of organic compounds and a few electrolytic organic syntheses. However, I found no systematic study of the electrolysis of organic compounds in general. I decided to make such a study myself with a view to possible adaptation of my findings to commercial production of certain compounds.

Experimental

The apparatus used consisted of a glass "U" tube 200 mm. long with side tubes. Wires were passed through cork stoppers and sealed in place with litharge-glycerine cement. The bottom end of each wire passed into a hole drilled into the top of a carbon rod electrode and was secured by filling the hole with solder. The wires were of such a length that when the stoppers were inserted into the "U" tube, the bottom of the electrodes extended about ¾ of the distance to the bottom of the tube.

Carbon electrodes were selected because of their chemical inertness and ready availability. Realizing the importance of using the proper electrodes in inorganic electrolyses, one of the directions in which I shall continue will be to repeat my experiments with different types of electrodes, noting the electrodes which give the highest and purest yield of the sought-after compound in each case.

The electrodes used were extracted from two size D Eveready flashlight cells. They were heated to redness and dipped into concentrated nitric acid three times, heated to redness again, allowed to cool and washed with water before fastening to the wires. After each substance was electrolyzed, the electrodes were detached from the wires, cleaned, heated and acid-dipped, washed, and re-attached.

The power source consisted of a 24 volt toy train transformer, an electrolytic rectifier, and a filter. The rectifier consisted of a carbon rod from a number 6 dry cell and an aluminum sheet 20 cm. x 20 cm. x 0.10 cm. immersed in a liter of saturated sodium bicarbonate solution. The filter is a single section choke-input filter using a 1.5 henry choke and a 1,500 microfarad capacitor.

All of the compounds tested were miscible or soluble in water. A small

quantity of substance was dissolved in distilled water and the solution poured into the "U" tube until the arms were ¾ full. A small amount of dilute sulfuric acid was added and a small piece of glass wool was inserted in the bottom of the tube to help separate the anodic and cathodic solutions. The stoppers carrying the electrodes were inserted and the power supply started. Gases evolved were collected through the side tubes. After the electrolysis was complete, the anodic and cathodic solutions were drawn off for analysis by means of a pipette.

All the products of these electrolyses were subjected to qualitative organic analysis. However, this method was not entirely satisfactory and I am awaiting an opportunity to be able to use quantitative analytical equipment so that I may clarify and further evaluate my findings.

Compounds Tested

Over a period of about ten months, I electrolyzed well over one hundred different compounds. Most of these were synthesized by myself and purified to a reasonable degree.

The compounds tested include a few of each of the lighter members of each class of aliphatic compounds and the corresponding aromatic compounds. The only compounds not tested were acids because of the fact that much work has apparently been done with these, and for fear of producing deadly cyanogen or hydrocyanic acid no organic nitriles or compounds containing a C-N group were electrolyzed. None of the carbohydrates or sulphur compounds were electrolyzed because it was found that apparently neither of these were in any way affected by electrolysis. Naturally, no compounds which react with water could be tested.

In the case of gases, these after purification, were bubbled through distilled water to produce a saturated solution which was then electrolyzed as described.

The results obtained were somewhat confusing. I believe this is due to the fact that I had to rely on the rather inexact methods of qualitative analysis. Nevertheless, I was able to draw a few conclusions.

The thing which impressed me immediately was the fact that rather than the usually simple anodic oxidation and cathodic reduction found in inorganic electrolyses, I found that a multitude of products were formed at each electrode.

Anodic Products

The gases evolved at the anode during the electrolyses of the aliphatic compounds seemed to be oxygen containing various amounts of different alkanes with perhaps a trace of an alkene at times.

Nearly all of the substances tested produced the corresponding acid at the anode with the exception of the monohydroxy alcohols which produced mixtures of aldehydes and acids, also traces of ketones. The polyhydroxy alcohols either did not noticeably react or else reacted, as evidenced by a discoloration of the anodic solution, but produced products I could not identify. The amides appeared to produce nearly equal amounts of acids and alcohols. The amines gave small amounts of the corresponding acids and apparently a mixture of various nitrogen containing substances which I have not been able to analyze.

The aromatic compounds produced

smaller yields than the aliphatics and as yet I have not been able to analyze the mixtures produced to a sufficiently high degree.

Cathodic Products

The gases evolved from the cathode appeared to be hydrogen containing a large quantity of some alkene, perhaps a mixture of alkenes. The amines produced ammonia at the same time.

A typical result was a mixture of a large number of compounds, none of which seemed to be present in any great quantity. Some of the products included several alcohols, ethyl acetate, a trace of formaldehyde and also amounts of ketones. Generally speaking, alcohols seemed to be produced in the greatest quantities.

Although in most cases the aromatic compounds seemed to match the behavior of the aliphatics, they had, in most cases, a tendency to resinify when the electrolysis was conducted for a long time in an attempt to produce enough material to analyze.

Future Considerations

It now seems to me that it should be possible to produce certain organic compounds electrolyticly. After analyzing the products more completely I shall perform experiments to determine whether or not one substance produced during an electrolysis may be considerably increased in quantity by varying the voltage used or by the using different electrodes. I am also curious about the electrolysis of the compounds I did not experiment with including the electrolysis of Grignard reagents, alkaloids, etc. In addition, the possibilities of the electrolysis of mixtures of compounds, especially mixtures of organic and inorganic compounds, seem interesting. After determining just how the yield of a given electrolytic product may be increased, with the help of an engineer I would like to see if it isn't possible to design an economical plant to produce such a product.

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Table of Results Obtained

The following table is intended to show a brief summary of the results I obtained with the various compounds electrolyzed. The compounds listed here are those which gave the most definite results for their particular class. Those marked with an asterisk (*) are some of those which I synthesized myself.

Compound	Anodic Products	Cathodic Products
ALKANES	no apparent results	no apparent results

ALKENES:		
ethylene°	O_2; trace of polyhydric alcohol	H_2; trace of an alkene
propylene°	O_2; trace of polyhydric alcohol	H_2; trace of an alkene
ALKYNES:		
acetylene°	O_2; an acid; trace of an alkane	H_2; acetaldehyde; mixture of alcohols; ether(s); an alkene
ALCOHOLS:		
methyl	O_2; formaldehyde; an acid; trace of an alkane	H_2; an alkene
ethyl	O_2; an alkane; acetaldehyde; acetic acid	H_2; trace of acetone; trace of an alkene
propyl	O_2; an alkane; trace of an aldehyde	H_2; trace of ketone; alkene; trace of alkane
glycerol-ethylene glycol	slight discoloration of the solutions, no products positively identified	
benzyl alcohol°	O_2; trace of aldehyde	H_2; trace of ketone
phenyl ethyl°	O_2; trace of aldehyde; trace of alkane	H_2; trace of acetone
phenol	darkening of solution, no definite products detectable	H_2
ETHERS:		
diethyl	O_2; trace of aldehyde	H_2; trace of ketone
n-butyl	O_2; trace of aldehyde	H_2; trace of ketone
methyl butyl°	O_2; trace of aldehyde	H_2; trace of ketone
iso-propyl°	no definite products except for O_2 and H_2	
phenyl butyl°	O_2; some discoloration, no definite products	H_2; slight discoloration with no detectable products
ALDEHYDES:		
acetaldehyde	O_2; an alkane; methyl alcohol; trace of formaldehyde	H_2; an alkene; an acid; acetone; trace of an ester
propionaldehyde°	O_2; an alkane; an alcohol	H_2; trace of a ketone; trace of an alkene
benzaldehyde°	O_2; an acid	H_2; an alcohol
KETONES:		
acetone	O_2; an alkane; trace of an acid	H_2; an alcohol; trace of an alkene; an alkane
methyl ethyl°	O_2; trace of an acid	H_2; trace of an alcohol
ESTERS:		
methyl acetate°	O_2; acid; trace of alcohol	H_2; an alcohol
ethyl acetate°	O_2; trace of an alcohol; an acid	H_2; an alcohol
amyl acetate°	O_2; trace of an acid	H_2; trace of an alcohol
AMIDES:		
acetamide°	O_2; trace of an alkane; equal amounts of an acid and an alcohol	H_2; no other definite product
propionamide°	O_2; trace of an alkane; an acid; trace of an alcohol	H_2; no other definite product

AMINES:		
ethylamine*	O_2; trace of an alkane; trace of an aldehyde; an acid; certain nitrogenous compounds not yet identified	H_2; ammonia; an alcohol
amylamine*	O_2; unidentified nitrogen compounds; trace of an acid	H_2; trace of ammonia; trace of an alcohol
aniline	O_2; dark coloration of solution, products not identified	H_2; no apparent reaction

"Blue" Salt May Aid Rain Making

➤ "BLUE" SALT in the atmosphere may play an important role in making rain, a Canadian scientist told the American Meteorological Society meeting.

Dr. Henry M. Papee of the division of applied chemistry, National Research Council, Ottawa, said laboratory studies showed "blue" salt adsorbs water vapor much more readily than normal salt. The "blue" or activated salt, he suggested, is formed in the atmosphere by "radio-chemical excitation."

He prepared the "blue" salt by treating microcrystals of sodium chloride with radiofrequency waves. The surface of the treated salt decreases much more slowly than that of normal sodium chloride when exposed to water vapor, Dr. Papee reported.

The blue color is due to colloidal sodium on the outer surface and is "remarkably stable" at room temperatures, he said.

Whether rain is formed by the melting of ice crystals or the growth of tiny drops of water vapor, there must be a minute particle around which the crystal or the raindrop forms. Weathermen call such particles condensation nuclei.

Dr. Papee reported that the treated salt would provide a "much more efficient condensation nucleus" than ordinary salt.

Heat Steam to 1,500 Degrees

➤ STEAM is being heated to about 1,500 degrees Fahrenheit at 15,000 pounds pressure per square inch in a red-hot chrome steel chamber at the California Institute of Technology. It is being done as part of an international steam research program aimed at finding new ways to step up power output.

Present operating levels for industrial steam are about 1,000 degrees and 3,000 pounds per square inch, although the average is much lower. One of the problems to be overcome with high-temperature, high-pressure boilers is finding a metal lining that can withstand the corrosive action of the steam.

Mutations Controlled

A NEW, POWERFUL and controlled way to cause chromosomes to mutate, or change, has been discovered. When garlic root-tips growing in water were placed between two insulated electrodes, changes took place in the plant cells.

These changes were similar to those that can be produced by cosmic rays, by X-rays, or other ionizing radiation, such as are emitted by radioisotopes.

Under the action of an electric field set up between the electrodes, the garlic root cells showed a shortening of their chromosomes, irregular cell divisions, and irregularities in the chromosomal envelope, among other changes.

The work was described by Drs. John H. Heller and A. A. Teixeira-Pinto of the New England Institute for Medical Research, Ridgefield, Conn., in the British scientific journal, *Nature* (March 28).

The electrodes were attached to an electric generator that produced radio frequencies in the megacycle (short wave) range. To minimize heating the specimen, 80 to 180 pulses per second of this radio energy in bursts of one twenty-thousandth of a second were "shot" to the electrodes for five minutes. The garlic root tips were observed 24 hours later and the cell changes were noted.

Experiments with living protozoa showed these microorganisms could move in a direction only along the lines of force while the electric field was on. As soon as it was switched off, they resumed a random movement.

Heating of the cells was low enough not to hurt the viability of either these organisms or mamalian cells, the scientists reported.

"In a larger, immobilized microorganism we were able to observe intracellular orientation of subcellular particles," they said. "This led us to believe that this force might be used as a powerful and controlled mutagenic agent."

The method may be used to induce cellular changes to a degree depending upon frequency, pulse, power, exposure time, and the way the cell lines up its axis with respect to the electric field.

On the Back Cover

THIS BOW-TIED *Martian has a Cyclopean eye that can take pictures through 12-inch thicknesses of steel! Actually it's just a camera angle that gives this man such a fearsome head. He's not "wearing," just positioning, Picker X-Ray Corporation's radioisotope machine called, appropriately enough, "Cyclops."*

The highest-capacity radioisotope unit installed for industrial use in the U. S. A., it requires a special concrete blockhouse at Cooper Alloy Corporation, Hillside, N. J. (The chains are just used to move the heavy Cobalt 60 sourcehead; the man gets out of there before it starts emitting its gamma rays.)

For the Home Lab

Orange Dyes

by Burton L. Hawk

In 1876 the first acidic azo dyes were marketed. They were brilliant orange in color and were known, for want of better names, simply as Orange I and Orange II. There has since been added an Orange III, which is more commonly known as Methyl Orange, and an Orange IV, also known as Diphenylamine Orange.

Of the above oranges, Orange II is by far the most common. In fact, it is still one of the most commonly used of all dyes. From an acid bath, it dyes wool a beautiful orange color. It is prepared by coupling diazotized sulfanilic acid with Beta-naphthol.

Pre-treatment

The operation of diazotization is performed by treating the patient with nitrous acid at low temperatures. The reaction is considered complete when the mixture turns blue in the presence of starch-iodide paper, which indicates the presence of free nitrous acid. Hence, our first step is to prepare the starch-iodide paper. Thoroughly mix one gram of starch with about 10 cc. of cold water in a mortar. Be sure the mixture is smooth and free from lumps. Add to 200 cc. of boiling water, and allow to cool. Next, add ½ gram of potassium iodide and stir until completely dissolved. Filter paper is immersed in this solution and allowed to dry. The solution does not keep and must be freshly prepared and used immediately. When your filter paper is dry, test it by moistening it with a dilute solution of hydrochloric acid in which a small quantity of sodium nitrite is dissolved. The paper should turn blue.

Diazotization

Next, we proceed to the diazotization. Dissolve two pellets of sodium hydroxide in 50 cc. of water. Add 3½ grams of sulfanilic acid and stir until as much of the compound as possible is dissolved. Ice is added now to bring the temperature below 5 degrees. During the entire diazotization the temperature must not rise above 5 degrees. If necessary, more ice may be added during the reaction. After the desired temperature has been reached, 6 cc. of concentrated hydrochloric acid are added. In another container, dissolve 1½ grams of sodium nitrite in 10 cc. of water. This solution is then added, in small quantities, to the cold sulfanilic acid mixture. Stir thoroughly as each addition is made. Keep a thermometer in the solution at all times to make sure the temperature does not arise above 5 degrees. After you have made several additions, test the reaction by allowing a few drops of the solution to fall upon a piece of starch-iodide paper. If a blue color is formed *immediately*, the reaction may be considered complete and further additions are not necessary. If the color is developed after a slight time interval, it is disregarded. The blue color must be formed immediately and must remain. The diazo compound may separate out in fine needles. If this occurs, do

not attempt to isolate them; keep them in solution. Under no circumstances, attempt to dry these crystals; as many diazo compounds are explosive in the dry state.

Coupling Operation

Now we proceed to the *coupling* operation. The term "coupling" simply means the combination of a diazonium compound with a phenol or aromatic base to form azo dyes. Dissolve 1 gram of sodium hydroxide in 5 cc. of water. Add 3 grams of Beta-naphthol and stir until thoroughly mixed. Then add 40 cc. of water and stir until the solids have dissolved. If the solution becomes warm, be sure to cool before proceeding. The diazonium solution prepared above is carefully added, with constant stirring. Again, the temperature must not be allowed to rise above 8 degrees. Add more ice if necessary. The solution should turn orange as the reaction proceeds. If you continue stirring the dyestuff will separate out. A little salt may be added to complete the precipitation. The orange powder may be filtered off.

To prepare Orange I, proceed exactly as above but substitute Alpha-naphthol for the Beta-naphthol. Orange I is used as a coloring agent for foods, drugs, and cosmetics. It is a reddish-brown powder, soluble in water to form an orange-red solution.

Preparation of Orange III

To prepare Orange III, or Methyl Orange, the basic steps are performed as above, with some modifications. This time dissolve 5 grams of sulfanilic acid and 2 grams of sodium carbonate in 100 cc. of water. After effervescence ceases, cool the solution with ice to 5 degrees, as above. Next add a solution of 2 grams sodium nitrite dissolved in 15 cc. of water. The diazotization is performed by adding, in small portions, a solution of 4 cc. of concentrated hydrochloric acid dissolved in 25 cc. of water. (Note this is the opposite of the previous reactions, where we added the nitrite solution to the acid). Again, test for completion with starch-iodide paper.

For the coupling reaction, prepare a solution of 3 cc. dimethylaniline and 5 cc. concentrated hydrochloric acid dissolved in 15 cc. of water. Add ice to this solution and pour it carefully into the diazotized solution, with constant stirring. Again, keep the temperature below 8 degrees at all times. Allow the solution to stand for about five minutes. A deep red color should be formed. Next, add a solution of 3 grams sodium hydroxide dissolved in 10 cc. of water and heat the entire mixture gently until a uniform orange color is obtained. The sodium salt of the dye is precipitated by adding salt and allowing to cool. Filter the solution and dissolve the precipitate in hot water.

Methyl Orange is used as an indicator. Add hydrochloric acid to a portion of the orange solution prepared above. The lovely red color is formed in the presence of acids. Now add an excess of sodium hydroxide. The solution turns yellow.

Answers to CHEMISTRY QUIZ on page 26.

A - 3; B - 2; C - 2; D - 1; E - 3.

Hereditary Chemical of Life

➤ THE BASIC, simple hereditary chemical found in all living things, DNA, has been further simplified.

A dwarf virus known to infect and destroy sewage bacteria may be causing a profound change in our ideas on the mechanism of heredity.

A biochemist at the California Institute of Technology has reported that he has found this dwarf virus with only one strand, not two, of DNA. In this respect the virus might be described as a simpler form of life, Dr. Robert L. Sinsheimer explained.

It consists of a single strand of DNA, or deoxyribose nucleic acid, wrapped in a skin of protein. An additional simplification is that its DNA strand is composed of only one molecule compared with as many as ten molecules for some other viruses.

A new problem raised by this discovery is how does the virus duplicate itself or reproduce?

Until now it has been believed that when a living cell divides, the two intertwined DNA strands pull apart, each serving as a kind of template or mold upon which a complementary strand is assembled. When a virus invades a cell, it was thought, each strand "picks up" chemical compounds — nucleotides — from the cell fluid which then go into making new identical strands of DNA.

Now, Dr. Sinsheimer reported, it appears that a single strand is enough for the virus to multiply. Twenty minutes after the dwarf virus, Phi X, invades a cell, it forces the cell to manufacture about 300 Phi X viruses, each capable of infecting a new cell.

It is not known if the dwarf virus is unique or if other organisms have only one DNA strand. About two dozen kinds of DNA have been analyzed and all are in the double-strand form.

The single strand, however, appears to be built on the same pattern as the usual double strand DNA. It is made up of "beads" of nucleotides.

Dr. Sinsheimer's research is supported by the U. S. Public Health Service and the American Cancer Society. It is possible that an altered DNA may be responsible for the formation of cancer cells from normal cells that have been genetically changed.

Ozone Causes Tobacco Lesions

➤ OZONE GAS in slow-moving, polluted air may be the cause of "weather fleck" lesions on growing tobacco leaves, the U. S. Department of Agriculture has reported. This is the first time injury traceable to ozone has been determined in the eastern part of the country, where concentrations have been believed to be low.

Excessive amounts are generated chemically when sunlight contacts air contaminated by fumes from auto exhausts and industrial plants.

Losses from the injurious lesions have exceeded $1,000,000 in some years in the production of cigar-wrapper tobacco in the Connecticut Valley alone.

Protein-Like Molecule Built

➤ THE LARGEST man-made protein-like molecule has been produced. It is a pituitary hormone which causes darkening of human and animal skins.

The synthesis was achieved by Dr. Klaus Hofmann of the University of Pittsburgh department of chemistry.

Dr. Hofmann's work consisted chiefly of linking in a definite arrangement 13 amino acids, the building blocks of all proteins found in the human body. It required six years to make the first minute batch of the substance, which is known as a-MSH (melanocyte stimulating hormone).

The hormone is naturally produced in the anterior pituitary gland at the base of the brain.

The pituitary is the body's master gland, secreting a number of different hormones which both regulate body functions and stimulate other glands to produce their own sets of hormones.

Synthetic a-MSH may prove useful in treatment of various glandular disorders, such as albinism, caused by lack of the hormone.

As has been the case with many significant scientific achievements, Dr. Hofmann's work was an offshoot of another of his projects, the synthesis of the hormone ACTH. Here is the sequence of events leading to the achievement:

Six years ago, Dr. Hofmann began the ambitious project of producing ACTH synthetically. Some four years later, as his progress continued, Drs. A. B. Lerner and T. H. Lee at Yale University discovered a-MSH, isolating it from the pituitary glands of hogs.

Then, Dr. Lerner, in collaboration with Ieuan Harris of the University of Cambridge, took the molecule apart piece by piece and found that its amino acids were linked in exactly the same sequence as part of the ACTH molecule.

Light Decomposes Water

➤ A METHOD for decomposing water into its basic elements by means of a beam of light has been discovered by two New York University scientists. Their work apparently confirms certain theories dealing with photosynthesis in plants and may be useful in future studies concerning solar energy applications.

The method was developed in the course of basic research into the electrical properties of certain organic crystals. The studies were made by Dr. Hartmut Kallman, professor of physics at NYU, and Dr. Martin Pope, research scientist at the University's Institute of Mathematical Sciences. The results were reported in The Journal of Chemical Physics (February).

Laboratory equipment used in the project is similar to a solar battery, but the study involves the use of artificial ultraviolet light rather than sunlight. The organic crystal used is anthracene, an inexpensive chemical related to the moth ball chemical naphthalene.

A flat, circular crystal, five ten-thousandths of an inch thick and two one-hundredths of a square inch in area, is mounted in an electrical cell. Each of the two faces of the tiny wafer is bathed in a separate dilute salt solution. This is accomplished by mounting the crystal in a small window of a plastic divider that separates the two salt solutions.

When ultraviolet light is shone on one face of the crystal, the crystal becomes a battery, developing a potential of two-tenths of a volt. This voltage forces a current through a measuring circuit while the light is on. Measurements are made through two silver wires, one in each of the salt solutions.

The power developed by the tiny crystal is small, being of the order of a millionth of a millionth of a watt.

The fact that current flows through the cell is evidence that water is being decomposed, with hydrogen forming on one face of the crystal and oxygen on the other.

This result, the NYU scientists point out, may be of special significance in the study of photosynthesis, the still imperfectly understood process by which plants utilize solar energy to transform carbon dioxide and water into carbohydrates necessary for growth.

One explanation of photosynthesis places chlorophyll in the role of a photovoltaic generator, which becomes an electric battery under the influence of light. This battery, it is thought, causes water to decompose.

The NYU scientists' study indicates that it is indeed possible for light to decompose water directly if the light is first intercepted by a material of the appropriate molecular structure.

The project was supported by the Office of Naval Research and the Air Force Cambridge Research Center.

Thermoelectric Refrigeration

➤ THERMOELECTRIC refrigeration, based on direct conversion of heat to electric power, is likely to become a significant part of power demand within the next 18 months, the American Power Conference was told.

Dr. John C. R. Kelly Jr., manager, technology department, Westinghouse Research Laboratories, Pittsburgh, reported that thermoelectric efficiencies will soon be competitive with all but the most modern large central power stations.

Thermoelectric power generation, he said, is a simple and competitively efficient way to provide power for small and intermediate loads. It is likely to be useful in handling peak power demands, supplementing a central power station.

Dr. Kelly said practical thermoelectric refrigeration devices suitable for a variety of applications have been built and tested.

Equivalent in performance to present refrigerators, these new devices have the advantages of silence, becoming cold faster, and they are adaptable to almost any size or shape of task.

These new devices will begin to draw appreciable power by the end of 1960. Heat pumps, devices for heating and cooling, based on the thermoelectric principle are not too far in the future.

Tadpoles Aid Disease Research

➤ TADPOLES may soon be helping scientists study arthritis and other diseases of the connective tissue.

When they are reared in water containing certain chemical compounds known as nitriles, toad and salamander embryos develop tumors. These compounds produce tumors and lesions experimentally in the same way that an extract of sweet pea seed does, Barnet M. Levy of the University of Texas Dental Branch explained.

Scientists are interested in the compounds because of similarities between several human diseases of the connective tissue and this "experimental lathyrism" — so-called after Lathryus odoratus, the scientific name for the sweet pea.

Now, Dr. Levy reported, several more compounds have been found that cause lathyrism. These are all water-soluble aldehyde blocking agents causing tumors in the animals by the end of one week. The technique provides an accurate and fast screening method for seeking new lathyrism-causing agents, Dr. Levy said.

Our findings suggest that there may be some defect with the carbohydrate metabolism of the connective tissue ground substance, Dr. Levy concluded in *Science* (March 13).

Chemical Promises Improved Cotton

➤ WASH-AND-WEAR cottons that stay white through repeated launderings and have "outstanding crease retention and wrinkle resistance" are one of the latest success stories of the U. S. Department of Agriculture.

Working with various compounds trying to make cotton flame-resistant, USDA chemists G. L. Drake, Jr. and J. D. Guthrie found an organic phosphorus compound that also made fabric samples wrinkle resistant.

Currently the cost of the compound APO, or tris (1-aziridinyl) phosphine oxide, is the major obstacle to its use as a commercial treatment for cotton. Although most of it is now imported, limited production of APO in this country indicates it can be produced at lower cost.

The finish is applied by dipping the cotton fabric into a water solution of APO, removing the excess, and drying and "curing" the fabric at relatively high temperatures for short periods of time.

Find Cause of Boiler Corrosion

➤ SCIENTISTS at the University of Virginia have discovered that atmospheric oxygen, combined with oil ash, causes costly corrosion in crude-oil-fired steam boilers. Experiments at the University's Engineering Experiment Station have partly revealed the destructive chemical process, but not a way to stop it. The scientists believe the problem can be solved, however.

Chemical Destroys Virus

➤ A CHEMICAL DECOY at the molecular level is being used by a Harvard University scientist to prevent the harmful effects of two influenza viruses on the brain.

The chemical decoy has been effective in preventing convulsions and death due to the harmful effects of the viruses on the nervous system of animals. It has not yet been tested in humans. The research opens new potentials for the therapy of virus infections by using purified chemical substances which will compete with native receptor substances for the infecting viruses.

The investigations have been conducted by Dr. Samuel Bogoch and his associates of the Neurochemical Research Laboratory, Massachusetts Mental Health Center and the Department of Psychiatry, Harvard Medical School. Reports on the studies appear in the current issue of Virology and the January 3, 1959 issue of the British scientific journal Nature.

Their publications concern the ability of a chemical constituent isolated from the brain to intercept infectious influenza viruses before they can attach themselves to their normal chemical receptors in the brain.

The chemical constituent — brain ganglioside — responsible for intercepting the viruses, is a large molecular weight substance containing both carbohydrate and lipid components.

The influenza virus strains used in the brain research were those denoted NWS and PR8. The animals used in the research were mice.

"Injection of either of the influenza viruses into the brains of the mice," Dr. Bogoch wrote, "caused convulsions and death of the animals. But when brain ganglioside was injected before, together with or, in certain cases, after the viruses were injected into the brain, the neurotoxic effects were prevented."

On the basis of this research Dr. Bogoch theorizes that the added brain ganglioside is either chemically very similar to or identical with the natural receptor substance and thereby serves as a decoy to attract the virus away from its natural chemical receptor, thus preventing damage to the brain.

"The inhibitory effect," Dr. Bogoch noted, "can be achieved by injecting the brain ganglioside into the brain in extremely small amounts."

Prior investigation by Dr. Bogoch, which led to the animal experiments, had shown that the two influenza viruses could attach to the brain ganglioside outside the body. At that point he hypothesized that the native brain ganglioside or similar substance might be a specific receptor for the infecting viruses.

In Nature Dr. Bogoch and his colleagues also report on a second investigation demonstrating that brain ganglioside stimulates the clam heart. The clam heart has been shown to be highly sensitive only to two other substances from the central nervous system. "Brain ganglioside," Dr. Bogoch noted, "is the first large molecular weight glycolipid which has been shown to act in this manner."

Studies by Dr. Bogoch on the chemical structure of brain ganglioside led

him to postulate in 1957 that this and related substances are involved in membrane, transport and receptor functions. The new studies, he comments, add evidence to support this formulation and provide a new approach to a chemical understanding of how substances like salts and viruses cross living membranes.

"This understanding," he said, "is fundamental to the comprehension and control of phenomena as diverse as the transmission of the nerve impulse, the occurrence of viral infections in the brain, and the blood-brain barrier.

In addition, since substances chemically related to brain ganglioside may be constituents of the cell membranes of other organs, these studies may provide clues to the understanding of the chemical basis for the functioning of cell membranes throughout the body."

Further investigations will be devoted to a search for the mode of interaction between the brain ganglioside and the influenza virus and further therapeutic tests in animals and humans.

Dr. Bogoch is Director of the Neurochemical Research Laboratory at the Massachusetts Mental Health Center and Assistant in Psychiatry at the Harvard Medical School. His associates in these studies were, Dr. Eleanor S. Bogoch, Miss Patricia Lynch and Dr. Alvin S. Levine of the Neurochemical Research Laboratory.

The research has been supported in part by a grant from the United States Public Health Service.

Magnetism in Plastic

➤ A NEW flexible plastic can be magnetized in any direction and can be chopped into all sizes and shapes without losing its magnetic properties.

Developed by the B. F. Goodrich Company, Akron, Ohio, the plastic is being produced in strips at the rate of more than ten miles a week. The strips are intended for use on refrigerator doors, both to insulate and to keep the doors shut by magnetic attraction.

Robert Shornstheimer, a Goodrich product engineer, told Science Service that the plastic contains a magnetized metallic powder. He said the magnets are produced by melting a vinyl resin mixed with plasticizers and the powder, then extruding the mixture in the desired shape, and finally running the strips through a magnetic field.

The poles, instead of being at the ends of the strips, extend the entire length, the north pole along one edge and the south pole along the other edge. The poles also can be reversed along a single strip at intervals, so that they run north-south, south-north, north-south, etc. Or, as in ordinary magnets, they can be induced at the ends of the strips.

The permanency of the flexible magnet is about twice that of some small metal magnets now in use.

Although the magnets are being produced primarily for refrigerator doors, Mr. Shornstheimer believes that various industries will discover almost limitless uses for them.

Boron Drugs May Penetrate Brain Barrier

➤ THE POTENCY of boron compounds that might provide scientists with a selective brain tumor killer can be measured by their solubility in benzene.

Increased solubility in a fatty solvent is an important measure of the penetration of the brain by a drug, Dr. A. H. Soloway of the department of neurosurgery, Massachusetts General Hospital, Boston, reported in the journal *Science*.

The "neutron capture therapy" of nerve cell tumors has given scientists the possibility of destroying only diseased cells without affecting adjoining normal cells. When boron-10 captures a slow neutron, part of the large amount of energy liberated is shared by an alpha particle. This alpha particle is then propelled about 0.00035 inch — nine microns — through the brain tissue so that the radiation effects are confined to a small region, the part of the cell containing the capturing boron atom.

Boron compounds that show the greatest effects on the central nervous system and greater concentration in the normal brain relative to tumor do concentrate more in the lipid (fatty) solvent benzene, Dr. Soloway suggests.

Electric Sparks from Charged Waves

➤ AN ELECTRIC SPARK, called "the least understood of all physical phenomena," has been found to be produced by a series of electrically charged waves, which sweep rapidly back and forth to build up a channel to carry the current. Dr. Leonard B. Loeb of the University of California, who reported this finding to the American Physical Society, used an "electric eye" and new ultra-fast measuring equipment in his research. In the past, he said, before development of these powerful new devices, it would have been impossible to measure the waves that caused a one-inch electric spark.

Crystal Structure of Gene Carrier

➤ THE CRYSTAL structure of one part of the material believed to store and transport genetic information from generation to generation has been found.

Three scientists have determined the crystal structure of calcium thymidylate, the calcium salt of thymidylic acid that makes up a part of deoxyribonucleic acid, the basic cell chemical which determines hereditary characteristics.

Their studies were aimed at explaining the link between the biological role of deoxyribonucleic acid and its molecular structure.

Drs. P. Horn and V. Luzzati of the Macromolecule Research Center, Strasbourg, and Dr. K. N. Trueblood of the University of California, Los Angeles, reported their studies in the British scientific journal, *Nature* (March 28).

Do You Know

A new teaser column of interesting facts in the chemical world to set you thinking — and asking.

➤ NIACIN, or nicotinic acid, made by plants, is essential to good health in humans.

➤ The Atomic Energy Commission has increased the availability of the radioisotope krypton-85 for civilian uses to 100,000 curies per year.

➤ Manufactured quartz, like natural quartz, is a hard, translucent, crystalline material which plays a vital role in communications.

➤ Radioisotopes of cobalt, iron, nickel, and beryllium are being used experimentally to improve methods for extracting essential metals from raw materials that are difficult and expensive to treat.

➤ The possibility of disposing of radioactive wastes in natural salt formations is being explored.

➤ The high values of strontium-90 in wheat probably are due largely to surface pickups from particular rains and are not expected to show a steady rise.

➤ Ordinary salt, lime, calcium chloride, calcium acrylate and many other chemicals besides cement can bind solids.

➤ Semi-annual inspections of all chemists shops (drug stores) are required by law in England.

➤ The radioisotope, krypton-85, is finding increasing use for activating phosphors in self-luminous light sources.

➤ Scientists expect to find abundant amounts of uranium-235 on the moon.

➤ U. S. exports of polyethylene grew from 129,000,000 pounds in 1956 to 230,000,000 pounds in 1958.

➤ An aluminum submarine which will plumb ocean depths three miles below the surface and make extensive deep-sea exploration possible is being designed.

➤ Radiography is the third largest industrial application of radioisotopes.

➤ Tests are now being conducted on a combination of wood and plastic for a shoe heel.

➤ Magnetic storms, the "northern lights," and data gathered from radar observations of the ionosphere have been tied together in a single theory.

➤ High purity magnesium is essential as a reducing agent in the refinement of uranium and zirconium.

➤ One cubic foot of liquid oxygen is equivalent to 850 cubic feet of oxygen gas at atmospheric temperature and pressure.

➤ Humic acid may be the substance which helps to keep metals, such as iron, from washing out of the soil.

➤ The electron microscope has revealed that the seemingly solid, rock-like enamel of human teeth is actually permeated by submicroscopic organic fibrils.

➤ The use of aluminum as lagging, or exterior covering, is helping to pare the cost of protecting large outdoor boiler plants from the elements.

➤ Recoverable shale oil was estimated recently to be more than four times the known oil reserves of the world.

➤ The dormant top $\frac{1}{2}$" of grass and the dead leaves and other debris that shut off sunlight and water, impede the chlorophyll-producing action of turf.

➤ Nickel, when combined with molten nickel chloride at a temperature of about 1800 degrees Fahrenheit, will recrystallize into a purer state, leaving its impurities in the salt solution.

Book Condensations

SEMICONDUCTORS — N. B. Hanney, Ed. — *Reinhold,* 767 p., $15. Reference work on the physical chemistry and fundamental physics of semiconductors, with detailed analyses of important semiconducting materials.

SAFE HANDLING OF RADIOISOTOPES —*International Atomic Energy Agency (Internat'l Pubs.),* 99 p., paper, $1. First publication of the agency, located in Vienna.

WELDING OF PLASTICS — J. Alex Neumann and Frank J. Cockhoff — *Reinhold,* 279 p., illus., $7.25. Comprehensive treatment of all phases of this subject ranging from initial design procedures to final fabrication methods.

PERKIN CENTENARY LONDON: 100 Years of Synthetic Dyestuffs — John Read and others, foreward by Sir Robert Robinson — *Pergamon,* 136 p., illus., $7.50. Review of progress since Perkin's achievement which led to the virtual supersession of natural dyes by synthetic ones.

ELECTROPHORESIS: Theory, Methods, and Applications — Milan Bier, Ed. — *Academic,* 563 p., illus., $15. Collected essays of value to researchers concerned with proteins, polyelectrolytes, and colloids in general.

FILLER METALS FOR JOINING — Orville T. Barnett — *Reinhold,* 244 p., illus., $7. For the welding engineer and others concerned with material specifications.

PRECIPITATION FROM HOMOGENEOUS SOLUTION — Louis Gordon, Murrell L. Salutsky and Hobart H. Willard — *Wiley,* 187 p., $7.50. Presents analytical methods for accomplishing precipitation from homogeneous solution so efficiently as to make reprecipitation unnecessary.

NOMENCLATURE OF ORGANIC CHEMISTRY 1957 — International Union of Pure and Applied Chemistry — *Butterworths (Canada),* 92 p., $3. Definitive rules for hydrocarbon, heterocyclic systems and steroids, and tentative rules for the vitamin B_{12} field.

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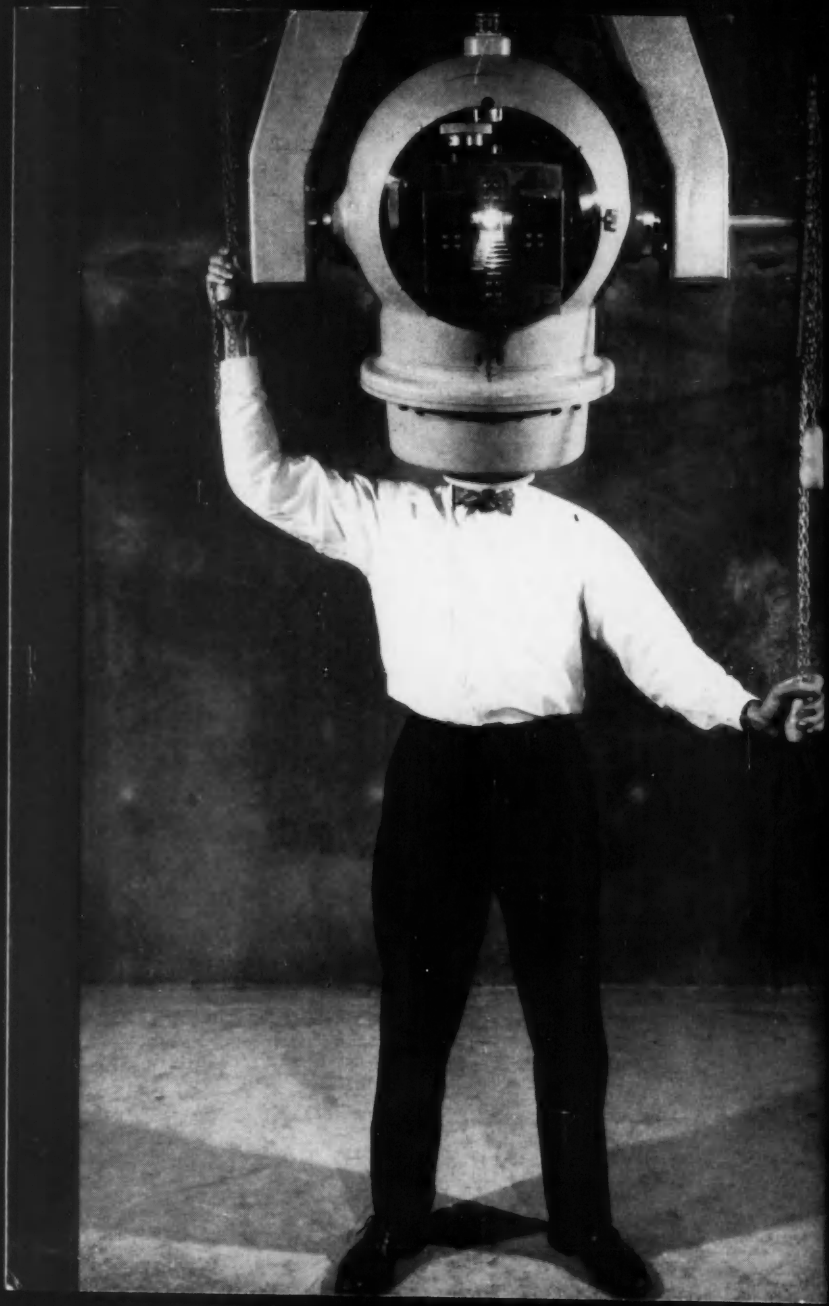

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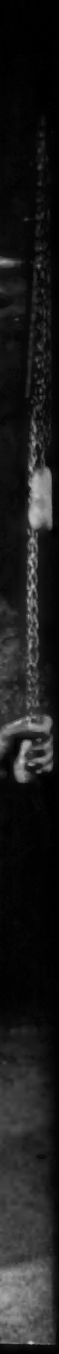

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